For engineers who design and manage the power and plant services

Power

MAY 1958

ONE DOLLAR

A McGRAW-HILL PUBLICATION

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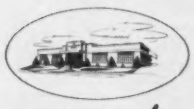
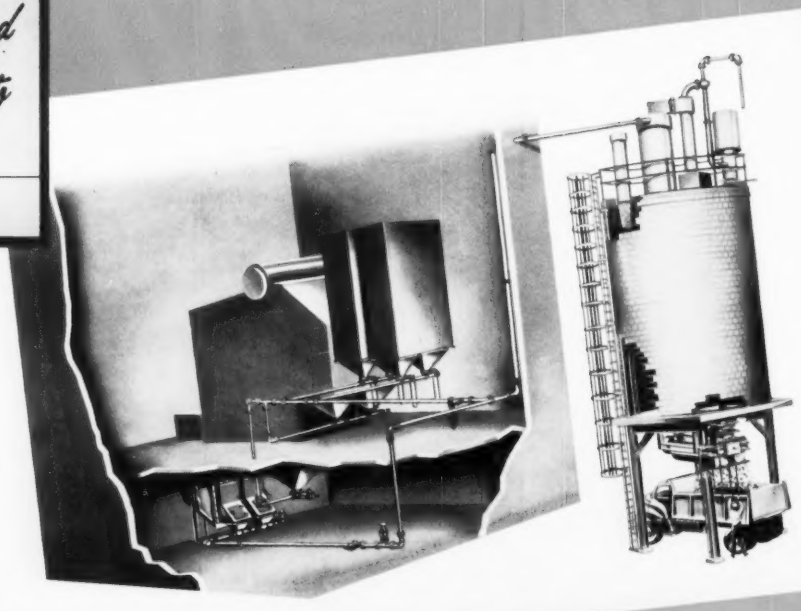


Small and Medium Sized Boiler Plants

PROPOSAL



ASHVAC A-S-H Pneumatic Bottom and Fly Ash Handling Systems*

For more than 36 years the Allen-Sherman-Hoff Company has been solving ash handling problems. The company has *project engineered* pneumatic bottom and fly ash handling systems—ASHVAC Systems—for small and medium sized boiler plants in every corner of the world.

The many systems we have installed in this period have naturally led to the standardization of many components common to most of these systems. This gives an important cost advantage to purchasers of ASHVAC Systems.

Plant layout and the design of other components do not lend themselves to standardization. These have been, and will continue to be, *project engineered* —giving the customer the advantages of "tailor-made" systems.

Control of manufacturing—A-S-H has operated its own plant since 1929—extends to the ASHVAC customer our advantages of quality control and delivery. This is also an important plus factor when repair parts are required.

If you are not familiar with the A-S-H ASHVAC Pneumatic Bottom and Fly Ash Handling System for Small and Medium Size Boiler Plants, it will be worth taking time to send immediately for our new ASHVAC literature. Then, call in your local A-S-H Field Engineer and talk with him about your problem. He's anxious to tackle your problem—no matter how small or how tough it might be.

Your first step towards better ash handling—send for Data Sheet Za—NOW.

*A-S-H service doesn't stop with installation. When service problems come up, we stand ready to give prompt service assistance. This is a policy worth considering when suppliers are being selected.

MATERIALS HANDLING SYSTEMS

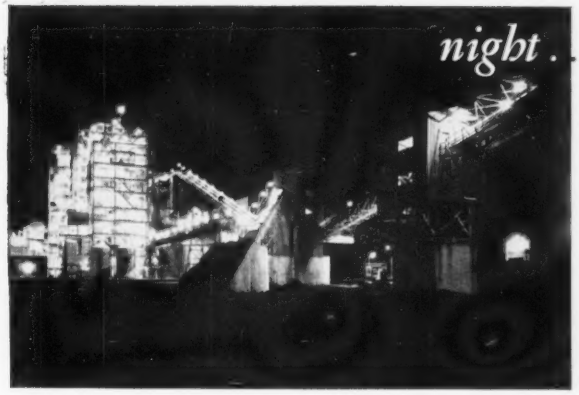
"Hydrojet" *hydraulic*

"Hydrovac" *pneumatic*

the **Allen-Sherman-Hoff** company

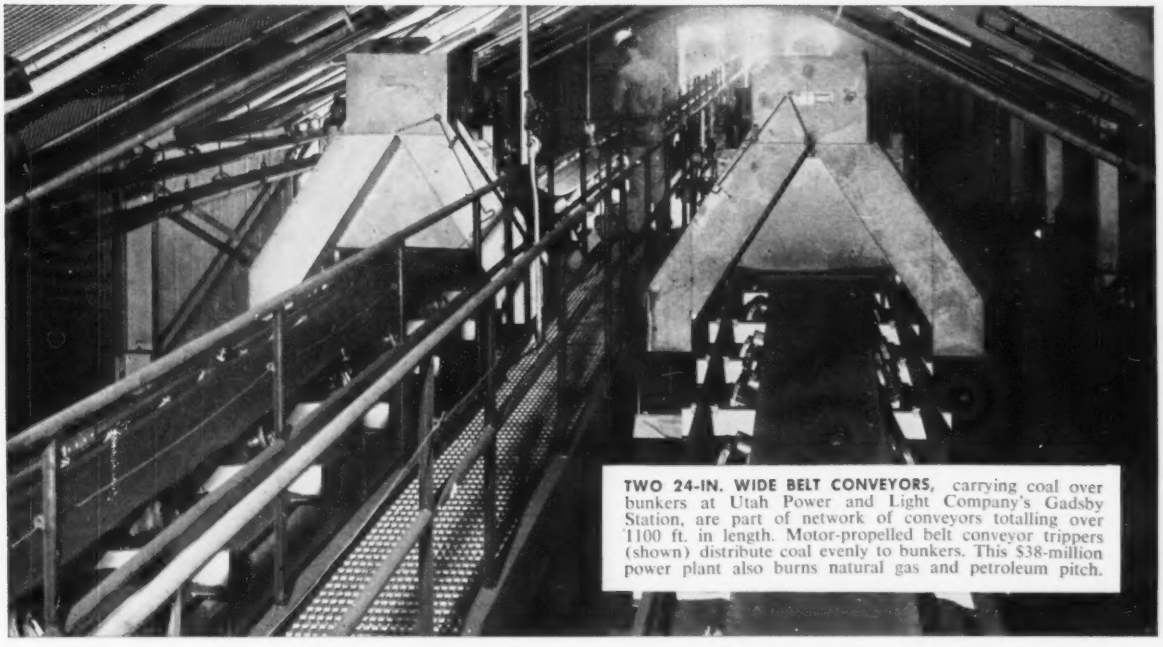
259 E. Lancaster Ave., Wynnewood, Pa.

Offices and representatives in principal cities



LINK-BELT coal-carrying conveyors prove

sure route to dependable power



TWO 24-IN. WIDE BELT CONVEYORS, carrying coal over bunkers at Utah Power and Light Company's Gadsby Station, are part of network of conveyors totalling over 1100 ft. in length. Motor-propelled belt conveyor trippers (shown) distribute coal evenly to bunkers. This $38-million power plant also burns natural gas and petroleum pitch.

Coal handling system at Utah Power and Light Co. can move 400 tph . . . has 100,000-ton storage capacity

GADSBY Station in Salt Lake City is one of the major power plants in the West that burns coal as an alternate fuel. Its two coal-burning boilers consume 1700 tons a day under full load. And to make sure the boilers always have an adequate and ready supply of fuel, this 241,000-kilowatt plant utilizes an efficiently integrated Link-Belt coal handling system.

Working with the Bechtel Corporation, consulting engineers, Link-Belt furnished the system to handle coal smoothly and at low per-ton cost—from railroad cars to crusher . . . to and from storage . . . to bunkers.

Whether your coal handling problems involve unloading, storing, weighing, reclaiming, elevating or feeding—Link-Belt's vast experience and complete line of equipment can work for you. Get complete details from your nearest Link-Belt office. Or write for Book 2410, containing the latest layouts and equipment for power plants, large and small.

14,708

LINK-BELT

COAL HANDLING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville (Sydney), N.S.W.; South Africa, Springs. Representatives Throughout the World.

DE LAVAL
IMO PUMPS

are now more versatile than ever

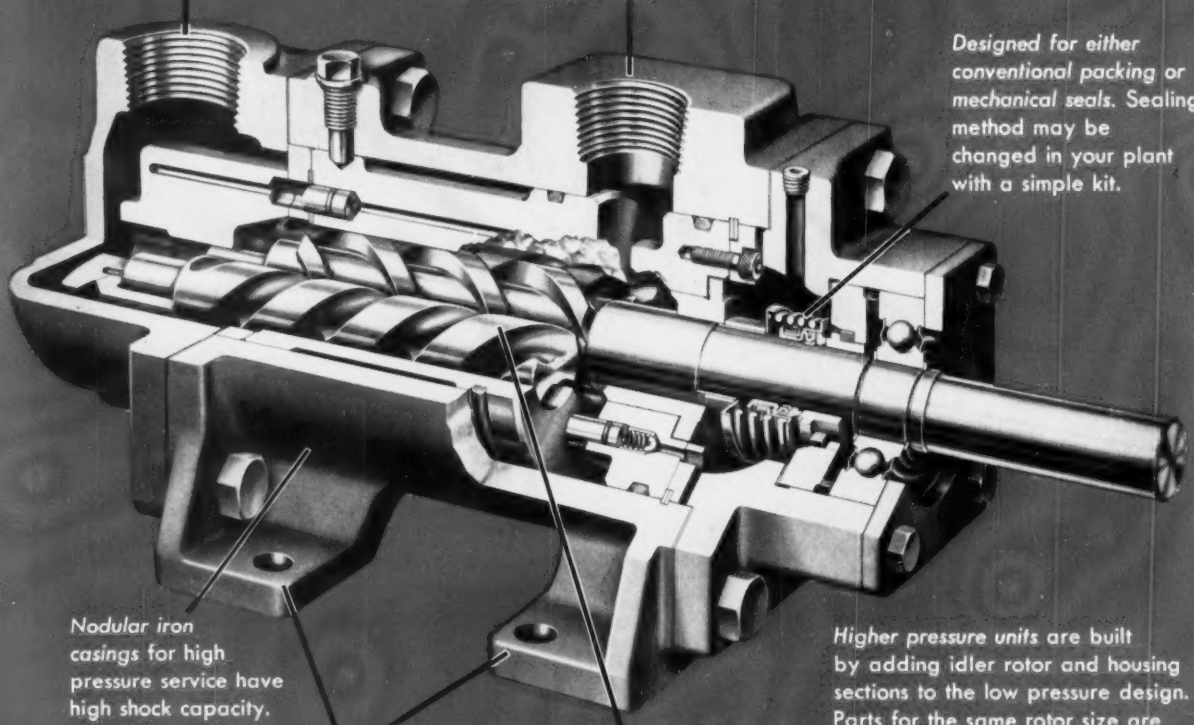
De Laval IMO pumps have proved that they do a dependable job over long years of service. The reason is IMO design simplicity. These constant displacement rotary pumps have only three moving parts—smoothly intermeshing rotors that propel the fluid axially in a steady flow without churning, pocketing or pulsation. There are no timing gears, cams, valves, sliding vanes, or reciprocating parts to wear or become noisy. *Quiet*, compact IMO pumps are excellent for direct-connected, high-speed operation.

In addition to these basic pumping advantages, the improved IMO gives you important new benefits shown in the cutaway illustration below.

Inlet can be rotated to suit installation arrangement.

Discharge flanges are infinitely varied. You can use the most advantageous piping method to suit installation requirements.

DE LAVAL IMO PUMPS can also be used as hydraulic motors.



Designed for either conventional packing or mechanical seals. Sealing method may be changed in your plant with a simple kit.

Nodular iron castings for high pressure service have high shock capacity.

Any position mounting is possible without factory modification.

Higher pressure units are built by adding idler rotor and housing sections to the low pressure design. Parts for the same rotor size are interchangeable over the entire pressure range.

Internal parts are designed as a package so that units can be built into your machines.

Bulletin 3001 gives data on improved De Laval IMO pumps. Send for your copy today.

DE LAVAL *IMO Pumps*

DE LAVAL STEAM TURBINE COMPANY

815 Nottingham Way, Trenton 2, New Jersey

DL 418

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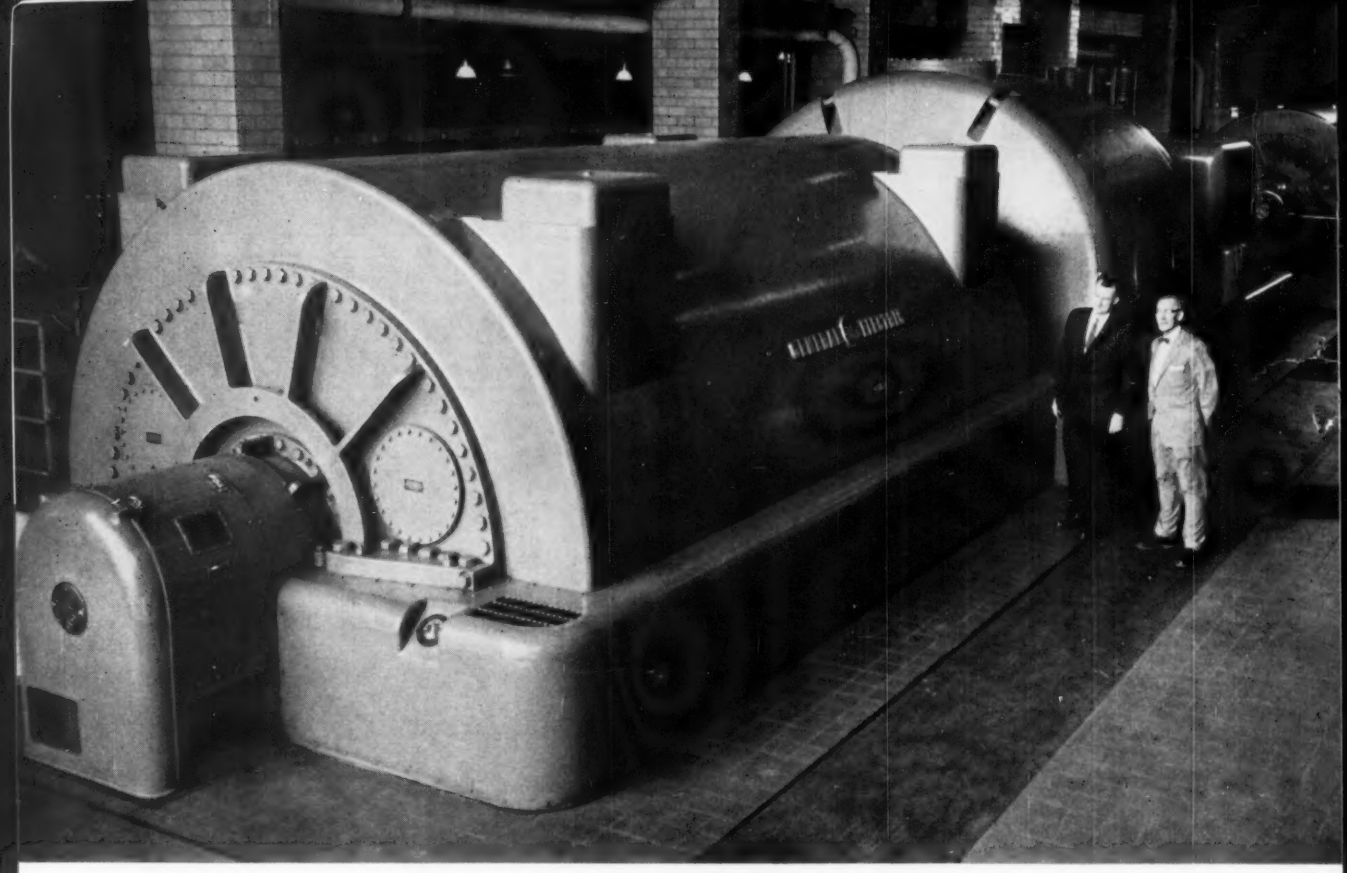

This new 70,000 kw reheat turbine—like all other turbines in this plant—is 100% Texaco-lubricated to keep it free from rust, sludge and foam.

A large Eastern Utility found:

Texaco gives these 3 big benefits for complete turbine protection:

1. Unquestionable dependability. Texaco Regal Oil R&O keeps the utility's turbine system clean; prevents rust, sludge and foam from forming; keeps bearing temperature normal and governor response instantaneous. Texaco dependability is a *fact* for this utility, based on long experience.

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3. Technical service. Texaco offers this important benefit at a time when power demands are almost out-growing turbine production. Past experience in the power plants has proved Texaco Lubrication Engineering Service to be quick and reliable. This service is always available to Texaco customers—whatever the need.

There is a complete line of Texaco Regal Oils R&O to meet the requirements of all leading turbine manufacturers, regardless of turbine type or size. Let a Texaco lubrication expert help you select the Texaco Regal Oil R&O that will keep turbine efficiency high and maintenance costs at a minimum. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States—or write:

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speaking of **Power**

Real reward for editors comes from reader response, clear indication that the customer has been served well and wants to say so. But, like other craftsmen, editors also enjoy opportunities to have their product judged by fellow "professionals" in the field of technical journalism. Such an opportunity is the Jesse H Neal Editorial Achievement program, sponsored by Associated Business Publications.

As this issue goes to press, POWER staffers are glowing in anticipation of the presentation, on May 1, of an Award of Merit in this annual competition. The winning effort is "The power field today and tomorrow," major article in last September's 75th anniversary issue. To compile this searching analysis of present and future practice, eight technical editors averaged more than a month's travel each, met with top engineers of over 150 equipment-manufacturing firms and consulting organizations. Then all 12 editors went to work on the mass of data collected, sifting for ideas of top significance and presenting them in a fact-packed 116-page "blueprint" for the power field's dynamic future.

Satisfaction also comes to editors from anticipating reader needs and meeting them at just the right time. When our April issue was nearing completion, winter storms were wreaking havoc around New York and many other parts of the country. Everything began to point to spring flood troubles. We hoped the waters wouldn't come but we knew that material on what to do before and after would always come in handy. So we tore the issue apart, worked overtime to assemble seven pages of practical know-how on flood fighting (April, pp 109-115). Now, in mid-April, with flood reports beginning to roll in, it looks as if the last-minute rush to get this into your hands before trouble struck was well worthwhile.

Reprints of this condensed manual on fighting floods and repairing water damage are available. Single copies free to POWER subscribers on request; quantity orders, sent to one address, 10c per copy.

Lou Lowley

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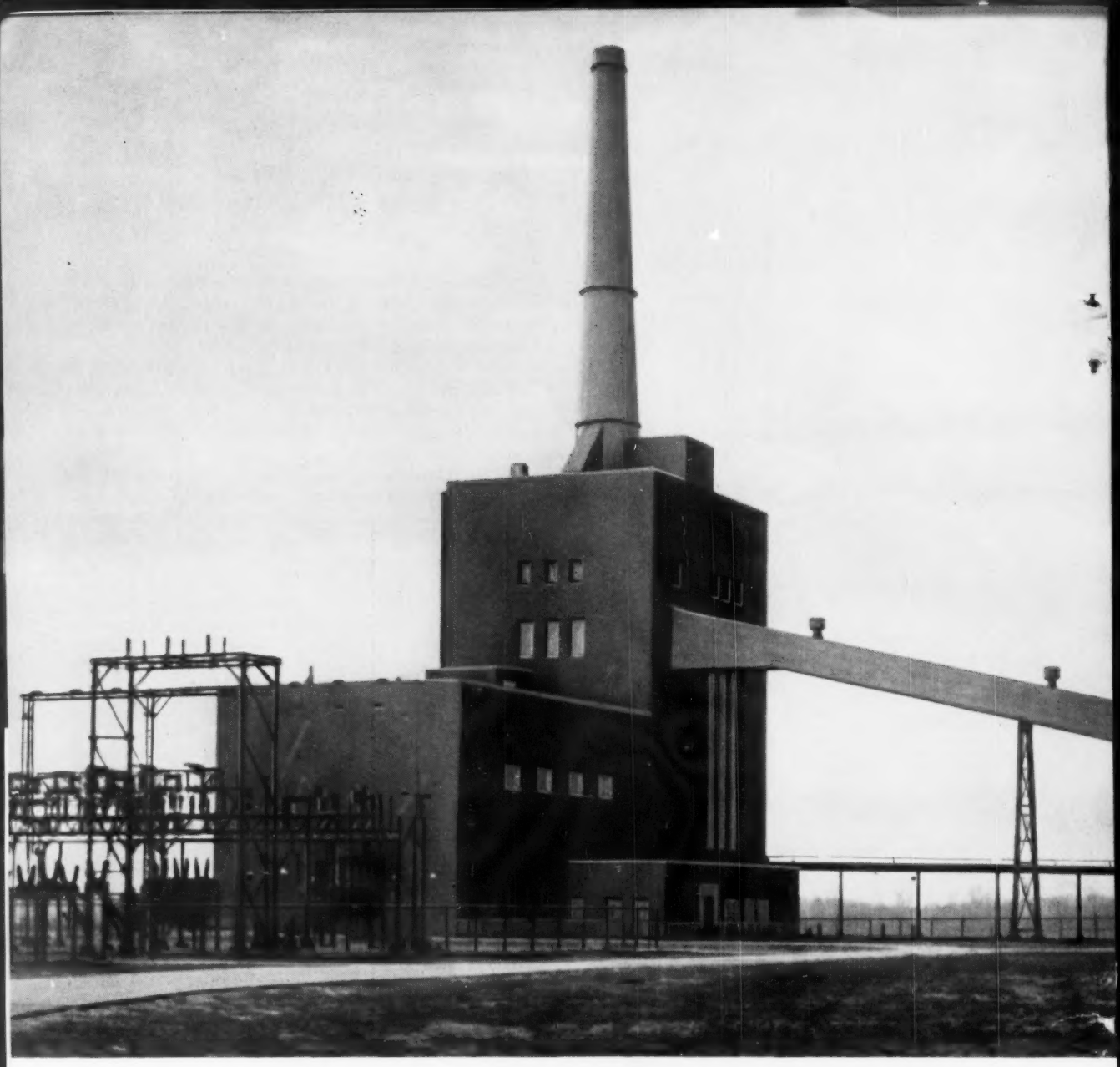


High Availability of B&W Boiler Brings

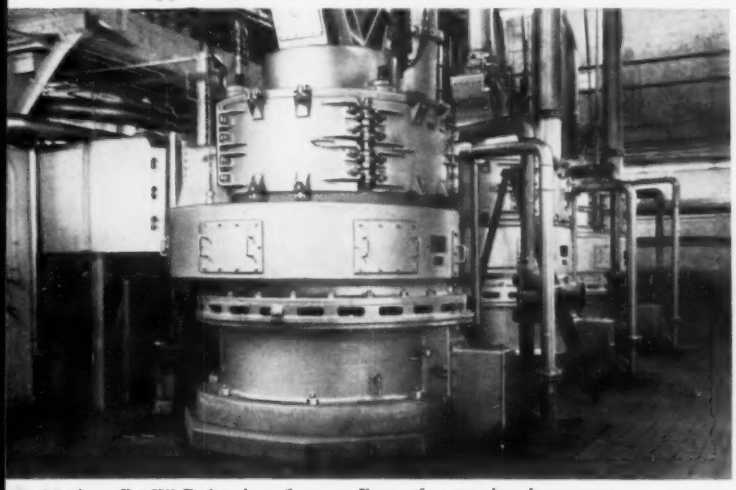
MORE LOW-COST POWER

"Excellent availability and performance." After two years of operation, this is the report on the B&W Radiant Boiler purchased by the Southern Indiana Gas & Electric Company. The unit is on the line at the Culley Station near Evansville, where it provides more low-cost power for the growing area.

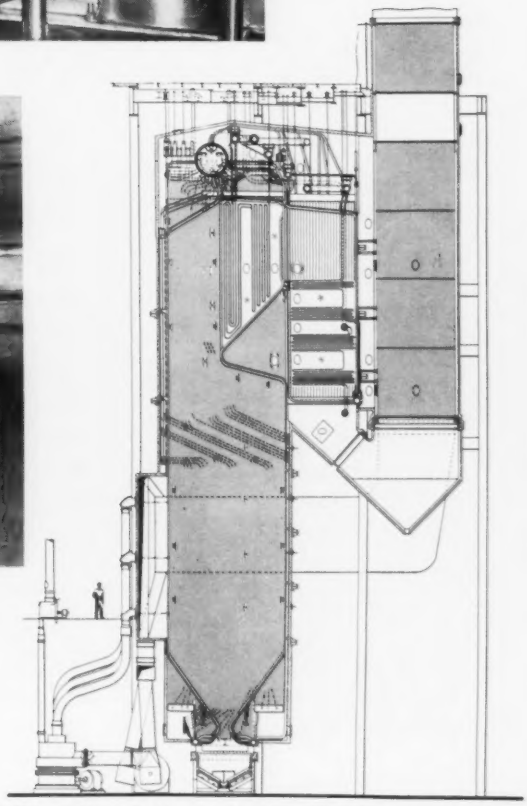
One major reason for the boiler's low operating and maintenance costs is the clean, dry steam assured by B&W Steam Separators. This keeps the turbine on the line for longer periods between cleanings and maintains higher turbine efficiency. Other important values include those made possible by B&W Pulverizers, which handle coal as received . . . wet or even iced . . . thus minimizing the danger of shutdown or loss of capacity. Pulverizers also grind coal to the specified fineness, thus assuring prompt ignition and complete combustion.

Advantages of B&W Boilers in central station operation are a result of B&W engineering advances in the development of economical energy, supported by nearly a century of steam generating experience.

Twenty-four tons of pulverized coal per hr are consumed by 6 burners supplied by 3 B&W Pulverizers.



• Modern B&W Pulverizer System. Ease of operation is an outstanding feature of the B&W Pulverizer since the entire system automatically proportions the primary air and fuel, utilizing only one damper to accomplish load changes.



B&W Radiant Boiler at the Southern Indiana Gas & Electric Company's Culley Station has steam capacity of 437,000 lb per hour at 1290 psi at superheater outlet and 950 F. Designed pressure 1450 psi. Net generating unit capability 44,000 kw. Consulting engineers: Commonwealth Associates, Inc.

TO INDIANA

Important, too, for Southern Indiana Gas & Electric is B&W's national network of plants and engineers. Progressive electric companies and their consulting engineers continually turn to B&W research, development, engineering, and design for assistance and advice. This pool of knowledge is available to help you meet your central station requirements. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

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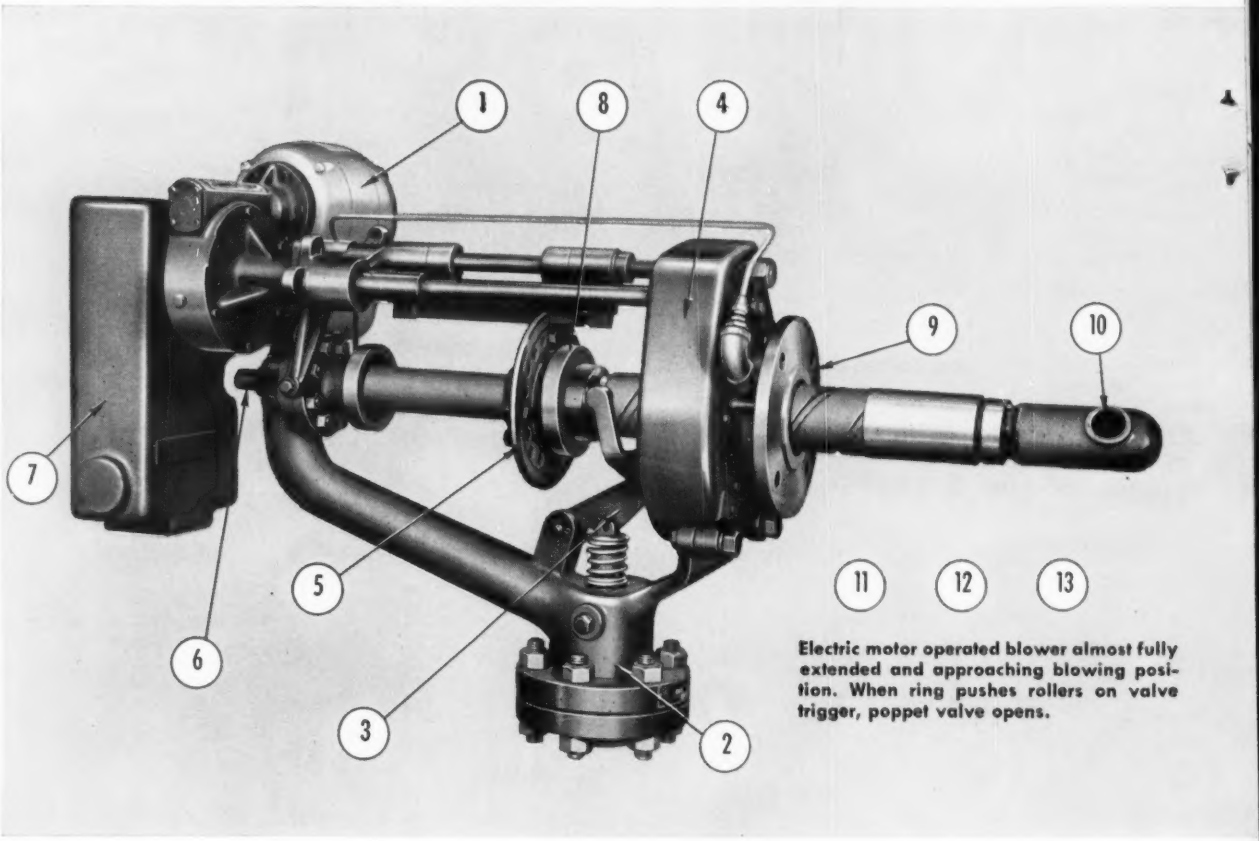
For BETTER Boiler Cleaning



Electric motor operated blower almost fully extended and approaching blowing position. When ring pushes rollers on valve trigger, poppet valve opens.

(1) Single motor (electric or air) both rotates and propels the nozzle

(2) New high-flow poppet type valve assures tight seating without critical adjustment, has welded-in seat with stellited surfaces available.

(3) Positive mechanical action of valve without pilot or diaphragm actuation

(4) Positive mechanical drive through gears for all operations

(5) Valve can open only when nozzle is in blowing position

(6) Adjustable control for individual unit blowing pressure . . . no orifice required in line

(7) Simple, reliable control for local or remote push button operation . . . easily adapted to automatic sequential operation (either air or electric)

(8) Blowing arc easily adjusted for position and extent (up to and including 360°)

(9) Simple mounting on all types of wall construction. No other external support needed. Can mount in any position permitting piping drainage

(10) Improved blower nozzle provides more *available* cleaning energy per pound of steam or compressed air

(11) Completely automatic from start to finish

(12) Suitable for outdoor use without protection except under very severe ice conditions

(13) All operating parts readily accessible for easy maintenance

at LOWER COST

IMPROVED Diamond

MODEL IR BLOWERS

(SHORT RETRACTING LANCE TYPE)

This improved Diamond Model IR Blower does a better job of cleaning water cooled furnace walls, hopper slopes or narrow portions of tube banks adjacent to walls. The retracting feature enables it to operate in zones of extremely high gas temperature; it will remove all dust and most slag deposits over a wide radius from the nozzle.

Cleaning furnace wall tubes effectively reduces gas temperatures leaving the furnace . . . improves overall efficiency of tube bank cleaning. Also, furnace wall cleaning contributes substantially to control of superheat and reheat steam temperatures on high-duty units.

Check the features listed on the left-hand page. For additional information on the improved Model IR, ask your local Diamond office or write directly to Lancaster for a copy of Bulletin 1079AU.

Diamond

DIAMOND POWER SPECIALTY CORP.

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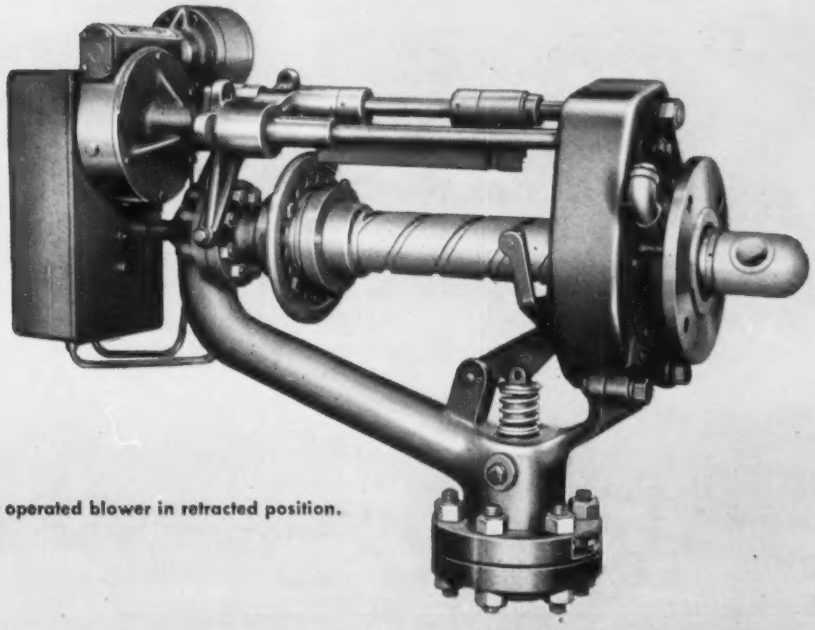

Air motor operated blower in retracted position.

Coal scores

with Notre Dame

University power plant burns coal for modern steam generation

Enrollment growth and building expansion had put a strain on the power plant at the University of Notre Dame, South Bend, Ind. After careful study—by the consulting firm of Albert Kahn Associated Architects and Engineers, of Detroit—a decision was made to modernize steam facilities and add power generating equipment. Two new coal-fired boilers, a turbo-generator and auxiliary equipment were installed.

Maximum efficiency is achieved through automatic combustion control and complete instrumentation. Today steam is generated *economically*. Another noteworthy result of these innovations has been the *cleanliness* of operation . . . making Notre Dame's power plant a model of good housekeeping.

Facts you should know about coal

You'll find that bituminous coal is not only the lowest-cost fuel in most industrial areas but up-to-date coal burning equipment can give you 15% to 50% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

To help you with industrial fuel problems the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send coupon below for our case history booklet, complete with data sheets. You'll find it informative.

Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

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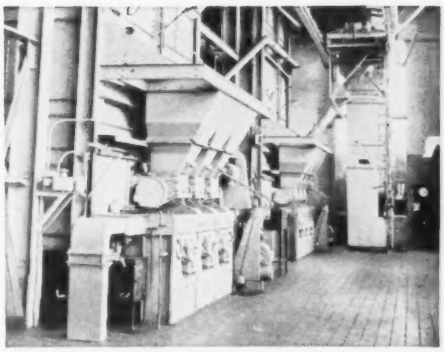
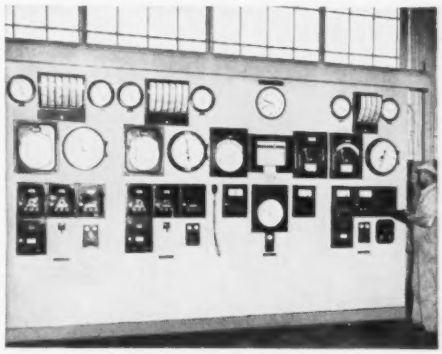
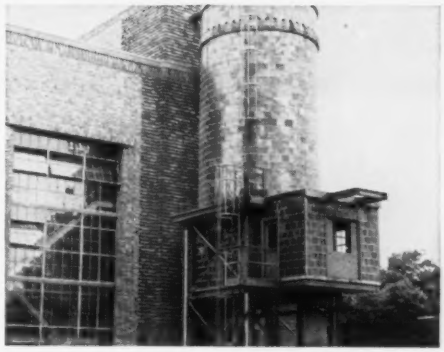


Firing aisle shows both Union Iron Works boilers . . . identical 2-drum, bent-tube type with a normal rating of 70,000 lb/hr. These units are fired by Detroit Rotograte Spreader Stokers.



All combustion controls and instruments are centered in this control panel by Hays Corp.



Furnace ash and dust from Prat-Daniel Collectors are conveyed pneumatically to this 50-ton ash storage silo. Rotary dustless unloader assures clean removal of material. Ash-handling system is by United Conveyor Corp.

SEND COUPON FOR YOUR COPY OF "Guide Specifications for Typical Low-Pressure Commercial Heating Plant." This booklet, adaptable for design loads 3,000 to 24,000 EDR steam, contains specifications, drawings and tables on all aspects of a typical heating plant. P-05

☐ Guide Specifications Booklet ☐ Case histories on larger plants

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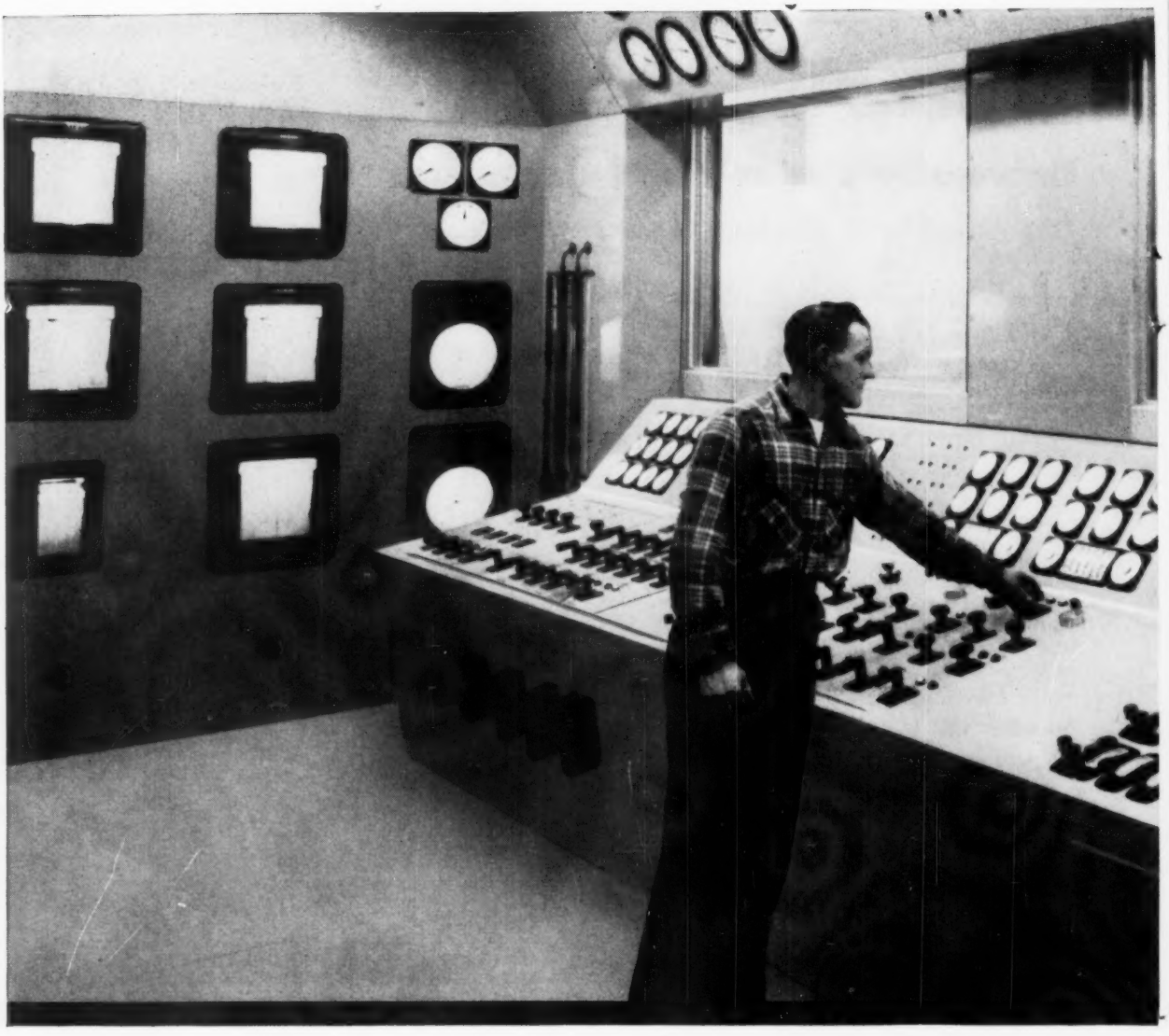


How Bailey helps you get a new

The thrill of putting a new station "on-the-line" can be marred if steam plant meters and controls don't work smoothly, efficiently. You are a lot surer of a fast, safe start and dependable operation for a long time when you specify Bailey Meters and Controls. They are keys to peak efficiency and low operating costs.

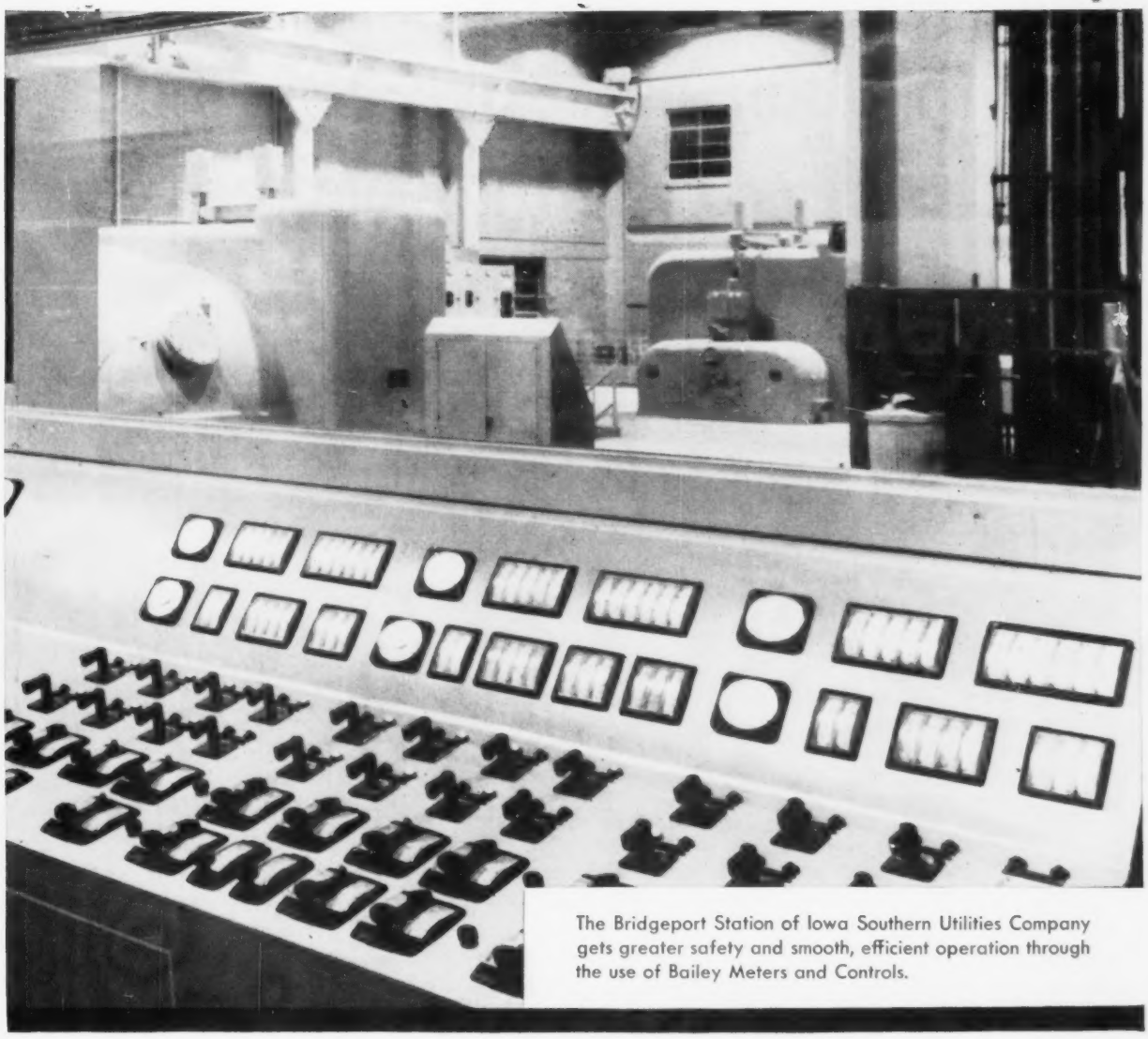
Bailey is the choice of virtually all the most efficient plants on the Federal Power Commission's heat rate report. Here's why:

1. A Complete Line of Equipment

You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work more efficiently for more than forty years. Veteran engineer and young engineer alike, the men



The Bridgeport Station of Iowa Southern Utilities Company gets greater safety and smooth, efficient operation through the use of Bailey Meters and Controls.

station off to a fast, safe start

who represent Bailey, are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.

A131-2

BAILEY METERS

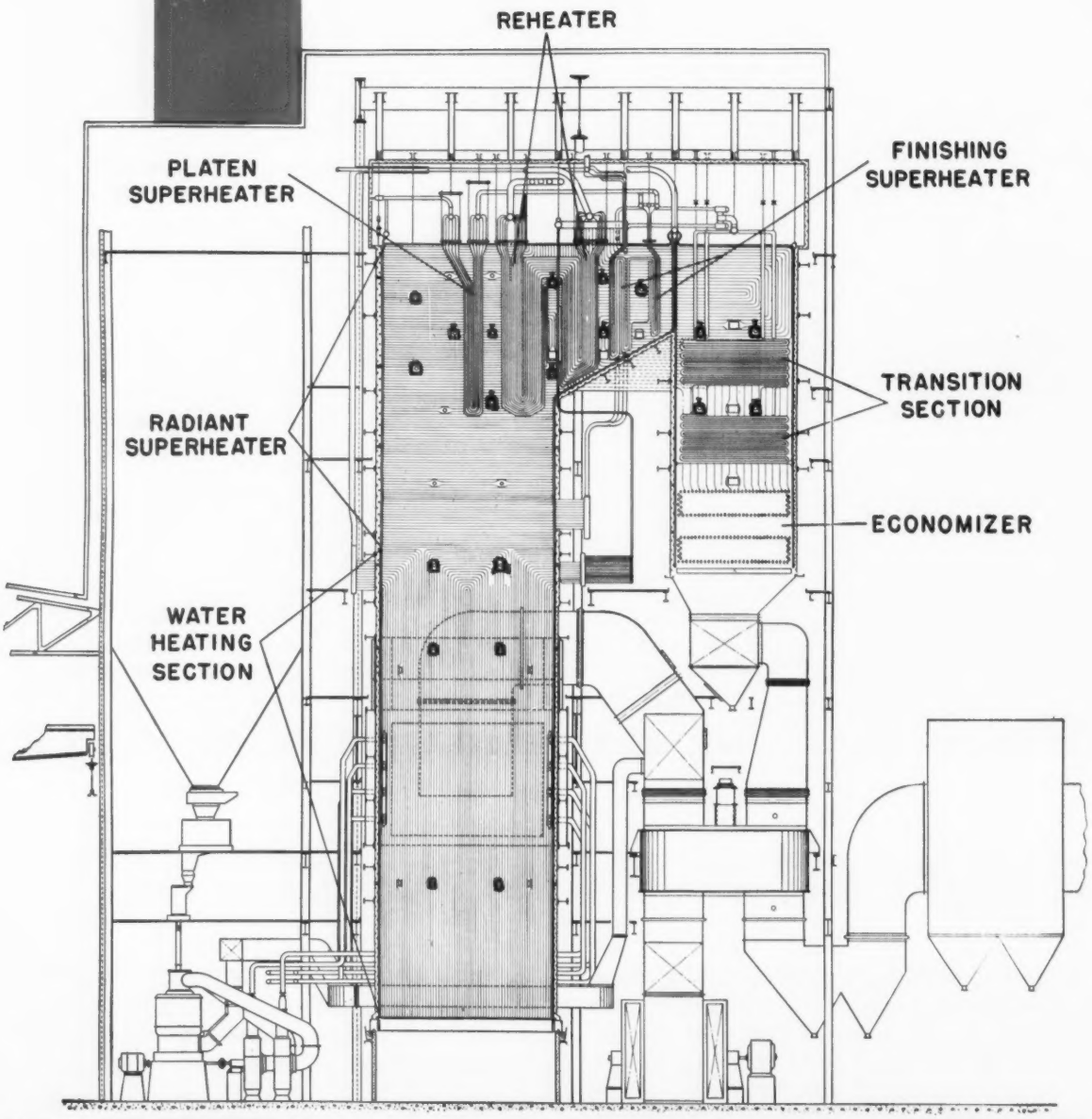
Instruments and controls for power and process

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal

Vulcan Selective-Sequence System picked for



The Cleveland Electric Illuminating Company
Avon Station Turbine Unit #8—Boiler #11
CE Sulzer Design
Boiler Capacity—1,715,000 lbs. per hour
Turbine Capability—250,000 KW
Steam Conditions at Turbine Throttle—3500 PSIG—1100F—1050F

Soot Blowing Avon Station

The Cleveland Electric Illuminating's new super-critical pressure unit at Avon Station will be equipped with Vulcan T-3-E long retractable soot blowers, RW-3E wall deslaggers and air-preheater cleaning controls. Blowing medium will be air with emergency steam stand-by—from existing boilers. Air will be furnished by a centrifugal air compressor. Selective-sequence control will provide precisely the sequence necessary for the most effective cleaning. Blowing sequences can be varied from a compact, pre-wired control board simply by means of patch cords. Thus, any blower can be operated at any point in the sequence. The entire cycle can be set to run automatically to completion, to recycle or to operate under clock control.

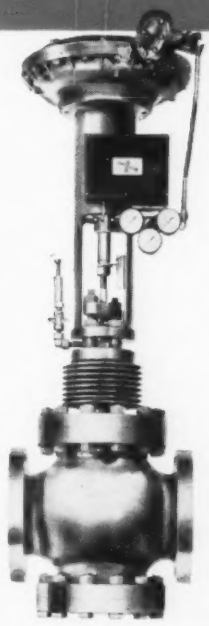
Modern Copes-Vulcan soot blowing systems such as the selective-sequence to be installed at Avon Station can help to keep your boilers operating at peak efficiency. Your Copes-Vulcan representative has the ideas, information and experience to help you make the selection best suited to your operation.

COPES VULCAN

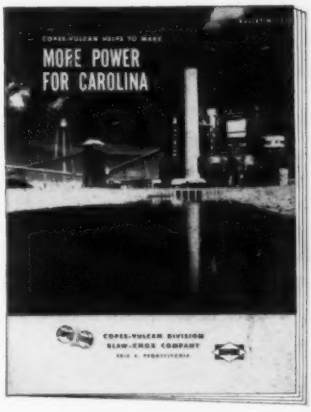
BLAW-KNOX

COPES-VULCAN DIVISION
BLAW-KNOX COMPANY
ERIE 4, PENNSYLVANIA

C-V NEWS NOTES

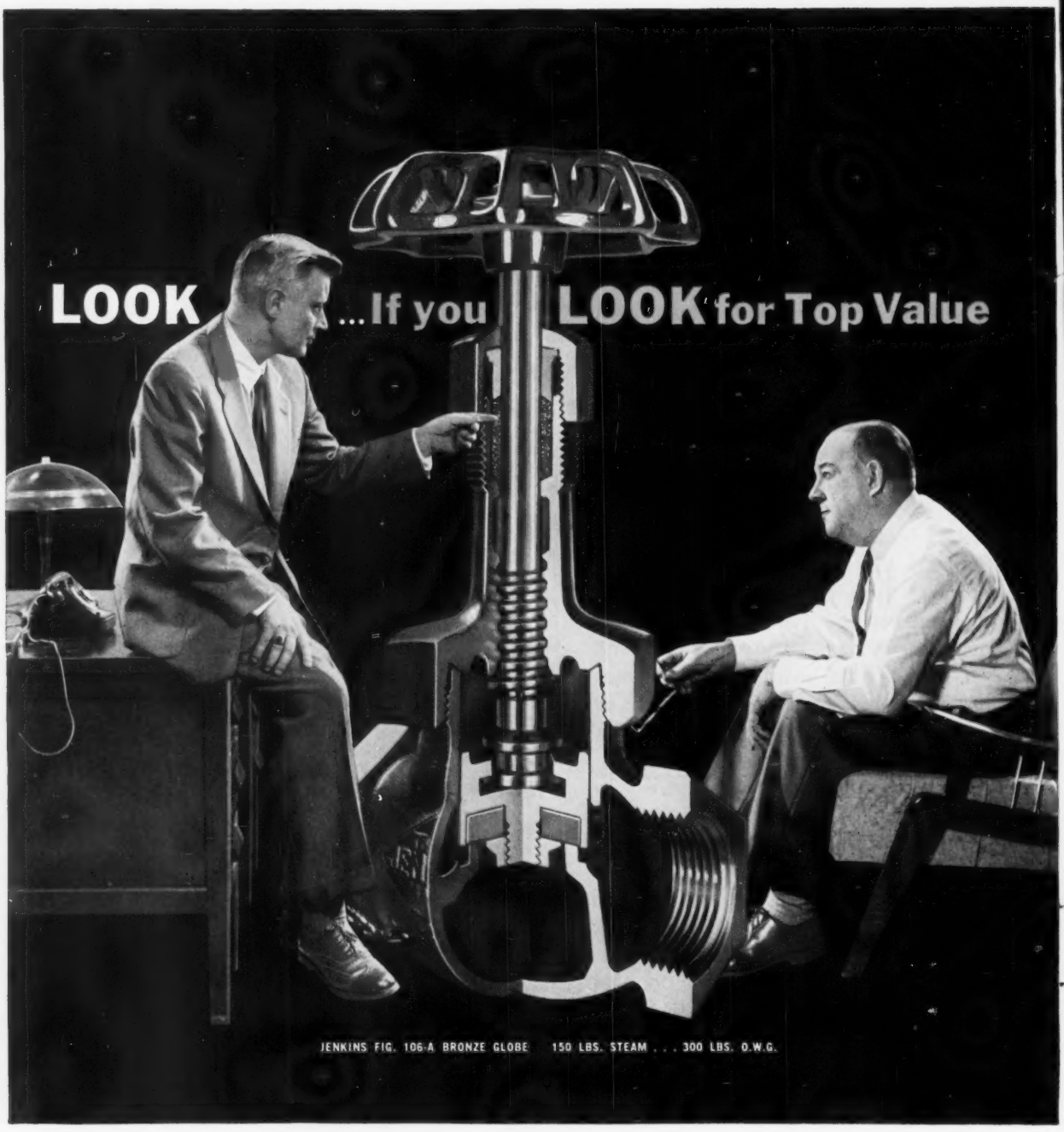


New Copes-Vulcan diaphragm-type CV-D valves have high rangeability, are either reverse or direct acting. They can be applied in sizes up to 12 inches at unlimited pressures.



Copes-Vulcan boiler control at Louis V. Sutton Steam Electric Generating Plant of Carolina Power & Light Company is described in Bulletin 1032. Your Copes-Vulcan man has a copy for you, or you may wish to write direct.

Unit 8 at Avon Station will get Copes-Vulcan pressure reducing and desuperheating station for energizing back-up soot blower steam supply. Copes-Vulcan desuperheaters will provide close control for all loads from 0 to 45,000 pounds per hour, with virtually instantaneous cycling.



THE FIRST renewable composition disc valve was a Jenkins Valve, originated nearly a century ago. Compare today's Fig. 106-A Bronze Globe with any other. See why so many valve users agree that a *Jenkins* is still the FIRST for top value. For descriptive folder No. 189-B on the full line of Jenkins Bronze Globe, Angle and Check Valves write to Jenkins Bros., 100 Park Avenue, New York 17.

Sold Through Leading Distributors Everywhere

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS SINCE 1864
Jenkins Bros.

in DISC EQUIPPED BRONZE VALVES

LOOK at that Wheel — Tough malleable iron. Design unequalled for cool, sure grip.

LOOK at the Index Plate — Has Fig. No. etched in green background. Held by wheel nut.

LOOK at the Wheel Nut — Secured by rolled-over spindle end. A quality detail.

LOOK at that Spindle — Made of high tensile bronze. See how much heavier it is . . . how many more deeply cut threads engage bonnet. And, the crowned head that reduces friction on disc holder. Sure, it costs more to make a spindle this way. But it reduces wear, preserves packing, means easier operation.

LOOK at the Packing Nut and Gland — Note the heavy and deep bronze hex. And, that bronze gland designed to compress packing toward spindle.

LOOK at that Packing Box — Its depth equals 1½ times spindle diameter. More packing space means less repacking. An asbestos, lubricated and graphited packing is used.

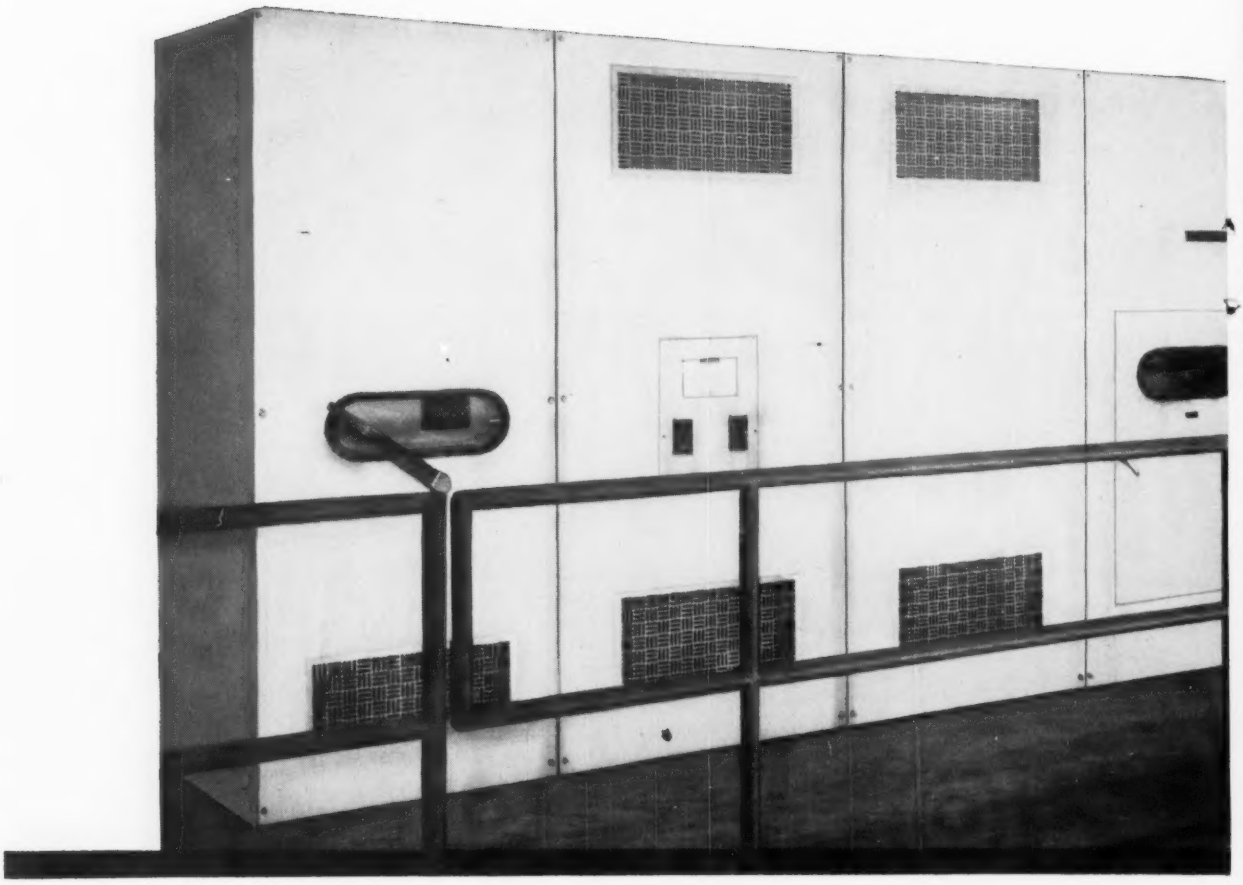
LOOK at that Bonnet — One-piece, screw-over design with big hex surfaces is easy to remove. Take an extra look at the bevel joint between bonnet and body, serving as an internal brace against the crushing effect of the bonnet assembly. Millions of Fig. 106-A in use for years prove this unique design licks distortion and springing.

LOOK at the Disc Holder — It's the Slip-on Stay-on type originated by Jenkins. Correct protective depth prevents flaking or cracking of disc.

LOOK at the Disc — Easily renewed without removing valve from line. Made of compositions to suit various services . . . and *made by Jenkins*, the only maker of both valves and discs.

LOOK at that Body — Just compare wall thickness of this high tensile bronze body with any other valve. The factor of safety is many times higher than rating requires. See the curved diaphragm to protect seat from distortion by pipe strain. Note that the raised seat is higher to permit more reseating operations . . . and wider, so it won't cut into disc. Pipe threads are full length and clean cut.

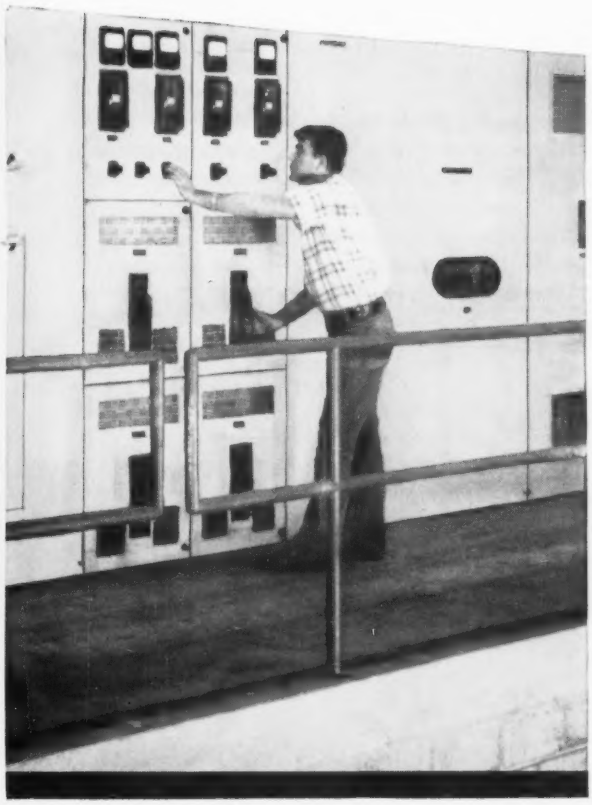
LOOK at this . . . for Throttling — Just replace the disc nut with this Throttling Nut and a Fig. 106-A becomes well-suited to throttling service. This unique nut reduces the effects of wire drawing and its long legs restrict flow for accurate control. Many plants take advantage of this versatile valve to reduce valve and parts inventory.



POWER-UP!

HARVEY ALUMINUM *did...*

doubled capacity, achieved more economical production than ever before!



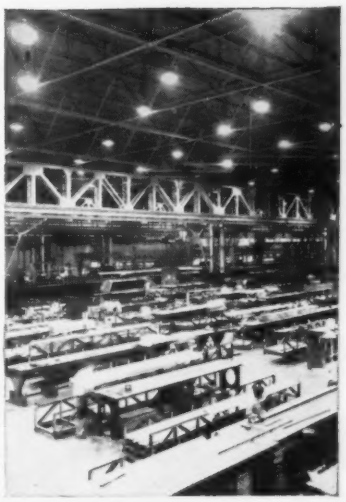
Seven Westinghouse spot network power centers located in major production areas supply motor loads, induction and resistance-type furnaces and the mercury lighting system.

Harvey Aluminum doubled productive capacity and cut per-pound production costs as well. Their large-scale expansion program had called for extrusions of unprecedented weight and dimensions. Investigation proved that flexible high-voltage electrical distribution was the primary power requirement. Two incoming circuits at 13.8 kv established primary voltage. A spot network system, comprised of seven load centers, was installed at major load points and serves equipment throughout the plant through low-impedance and plug-in bus duct. This basic system is ideal for unbalanced and shifting furnace-heating loads.

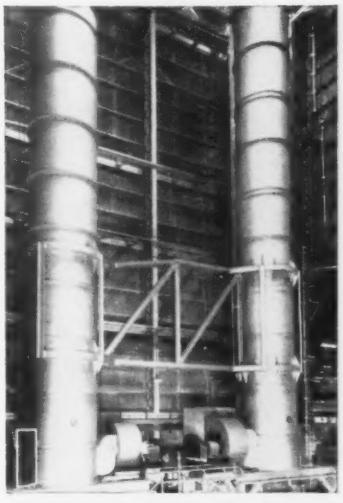
Service continuity is assured, and voltage regulation has measurably improved. Future relocation of machinery and unpredictable changes of equipment, too, have been provided for. This high order of electrical planning has helped maintain Harvey's position as one of the world's lowest cost producers of fabricated aluminum.

Is yours a problem of production changeover, new products, or rising costs and a profit squeeze? Your electric utility sales engineer or your Westinghouse representative can help you with a practical solution . . . Power-Up!

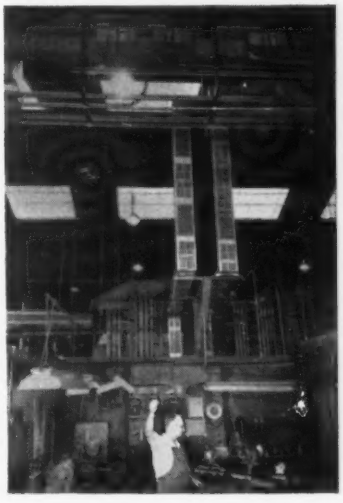
J-97218-A



"The Westinghouse 480-v color-corrected mercury-vapor lighting system is remarkably superior to conventional lighting," says Mr. Lawrence Harvey, Executive Vice President. "It is not only less expensive to operate at the same level of illumination, but replacement and maintenance costs are reduced."



Twin 110′ Westinghouse electric furnaces are powered by a specially engineered system providing for cyclical furnace loads, and at the same time, making maximum use of network capacity.



Westinghouse bus duct, carrying power throughout the plant, is another key to distribution system flexibility. Here, two runs of ventilated low-impedance duct from the transformer feed individual branch runs of 1000-amp plug-in duct.

YOU CAN BE SURE...IF IT'S Westinghouse

"BUFFALO" MATCHES FAN TO REQUIREMENTS

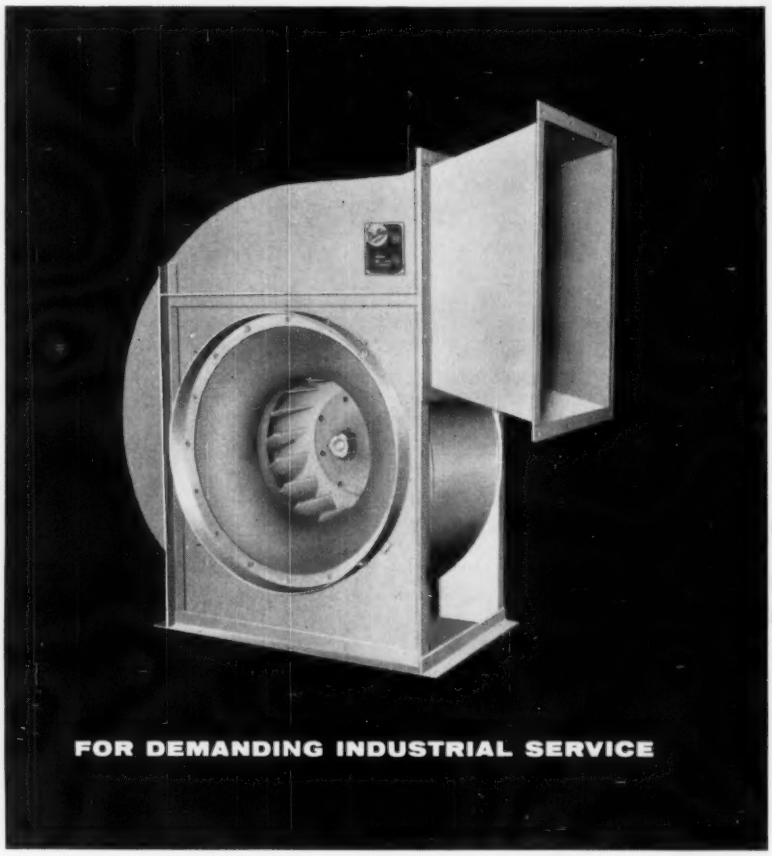
● "Buffalo" believes in designing specific *separate* fans to meet different performance requirements — not merely offering variations of the same basic fan design to meet varying needs.

Shown here are three of the many fans in the complete "Buffalo" line engineered to cover every type of heavy-duty industrial and power plant application.

These three "Buffalo" Fans — the "CR", the "BL" and the "BLH" — are designed to fulfill your central system or mechanical draft requirements with the highest possible efficiency, dependability and overall economy. Behind these fans are the 81 years of "Buffalo" research and engineering experience, plus up-to-the-minute design improvements, to insure a long life of useful service.

Whatever your requirements for heavy-duty air moving, whether for mechanical draft or ventilating purposes, there's one *right* "Buffalo" fan to do your job best. For expert engineering assistance, contact your nearest "Buffalo" Representative — or write for the Bulletins covering your needs.

The "Buffalo" Type "CR" Radial Blade Fan was specially designed for heavy-duty industrial and power plant service. It has gained wide acceptance for induced draft applications, particularly with stoker-fired or pulverized coal boilers. It is extensively used throughout the steel, cement, mining and many other industries. The rugged construction and wear-resistant qualities of the "CR" assure a long life of maintenance-free service. Its high capacity, high pressure performance may enable you to utilize a smaller, less expensive fan for many direct-connected requirements. For full information on the "Buffalo" Type "CR" Fan, write for Bulletin FD-205.



Every "Buffalo" Fan features the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

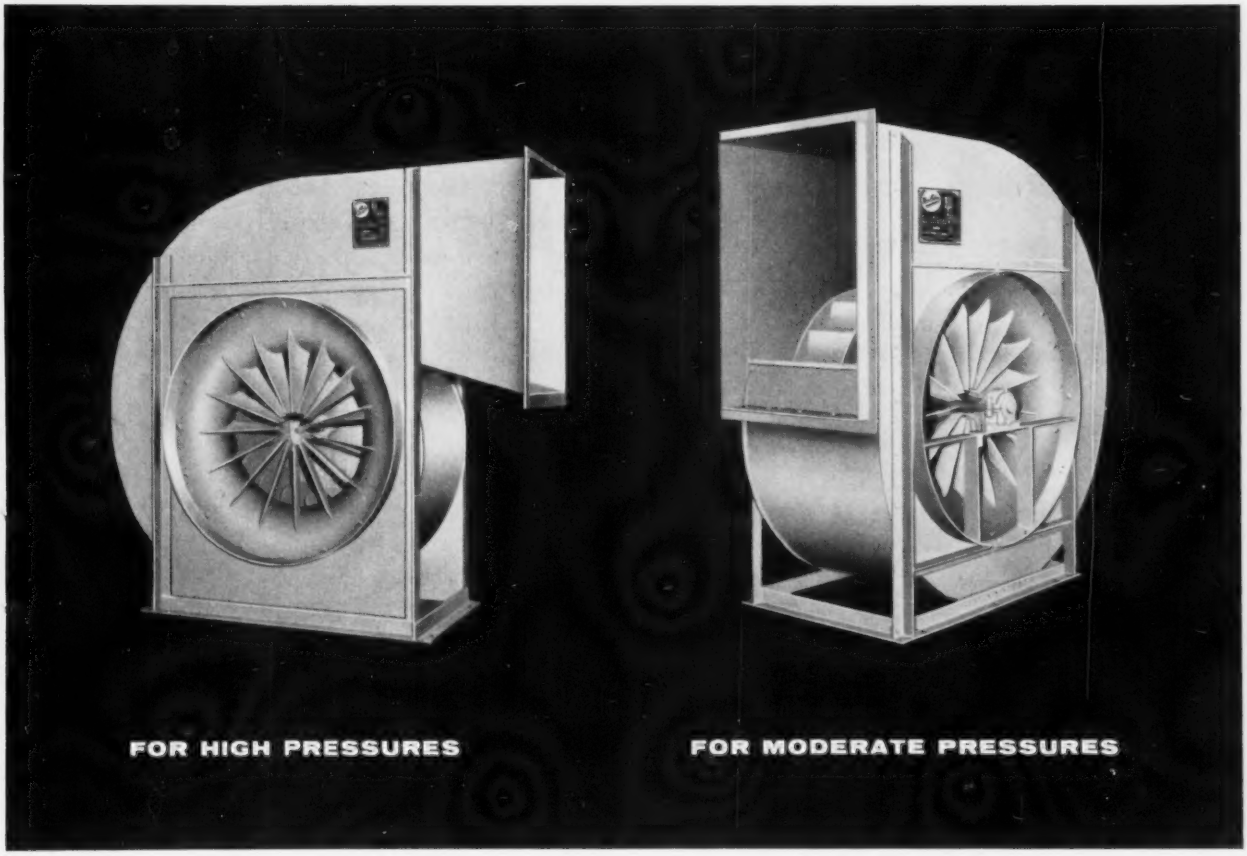
"Buffalo"

CANADIAN

EXACTLY—FOR ALL HEAVY-DUTY AIR MOVING

The "Buffalo" Type "BLH" Fan is unsurpassed for Classes III and IV mechanical draft and ventilating service. A combination of "Buffalo" engineering features insures a new high in performance over a broad efficiency range. The uniquely-designed housing provides smooth, streamlined air flow, extremely high static conversion and excellent pressure distribution at the fan outlet. Distortion-free inlet and smooth, backward-curved wheel blades also contribute to the "BLH" Fan's highly efficient performance and exceptionally stable operation over the entire range from free delivery to shut-off. A long, trouble-free life is assured by the traditionally sturdy "Buffalo" construction features. Write today for Bulletin F-200.

The "Buffalo" Type "BL" Fan is ideally suited for most conditions in Classes I and II mechanical draft service, and central system ventilating applications. High static efficiencies and minimum noise levels result from the unique "Buffalo" all-streamlined design of inlet, rotor and housing. The fixed inlet guide vanes and deep drawn, smoothly-curved inlet bell properly distributes the air flow into the wheel, minimizing inlet shock loss. Backward-curved blades provide the desirable non-overloading horsepower characteristic. Long-lived dependability is insured by such rugged construction features as die-formed and welded components. Write for Bulletin F-102 today.



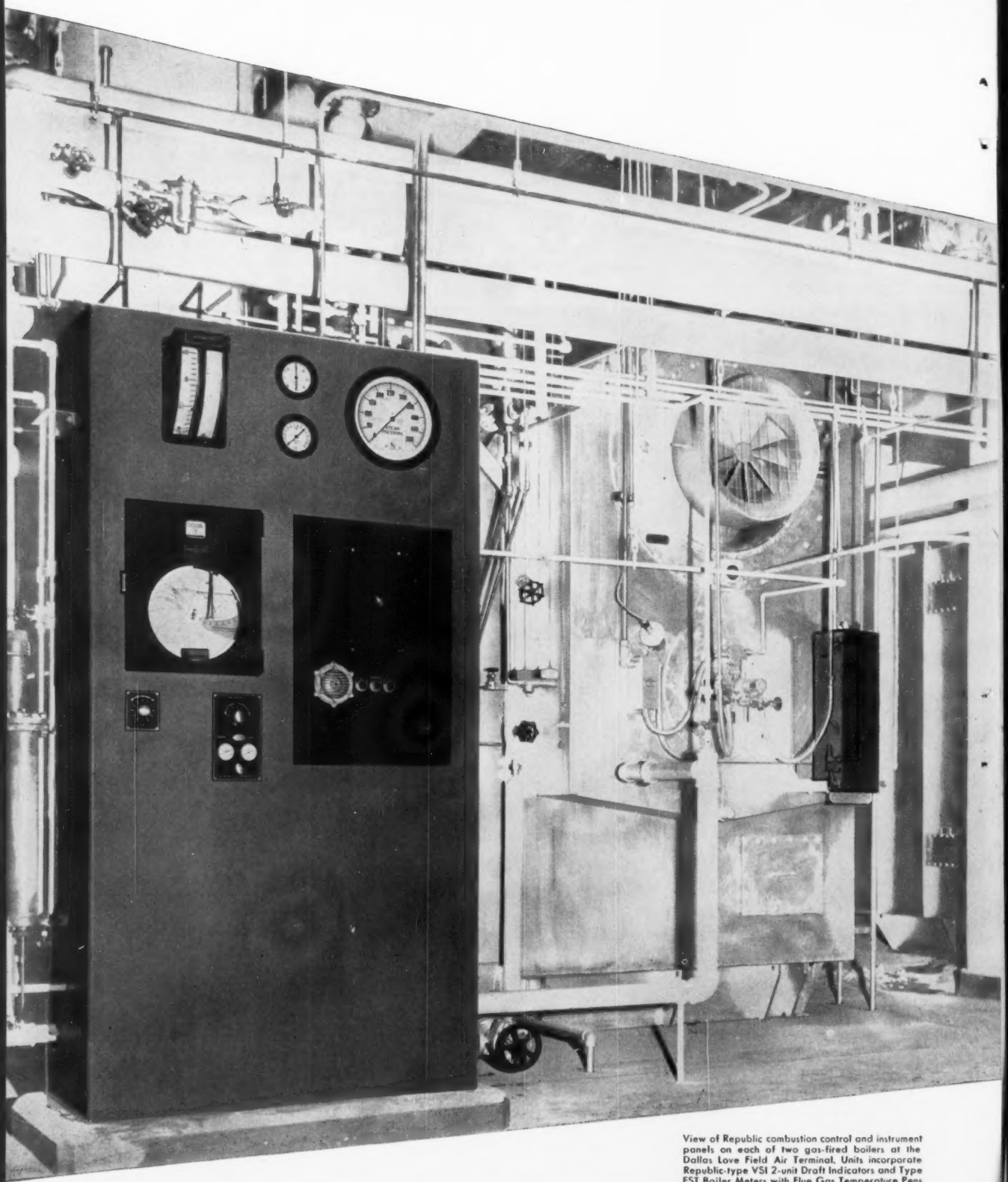
BUFFALO FORGE COMPANY
BUFFALO, NEW YORK

BLOWER & FORGE CO., LTD., KITCHENER, ONTARIO

VENTILATING
AIR CLEANING
AIR TEMPERING
INDUCED DRAFT
EXHAUSTING
FORCED DRAFT
COOLING
HEATING
PRESSURE BLOWING

ANOTHER REPUBLIC ACHIEVEMENT!

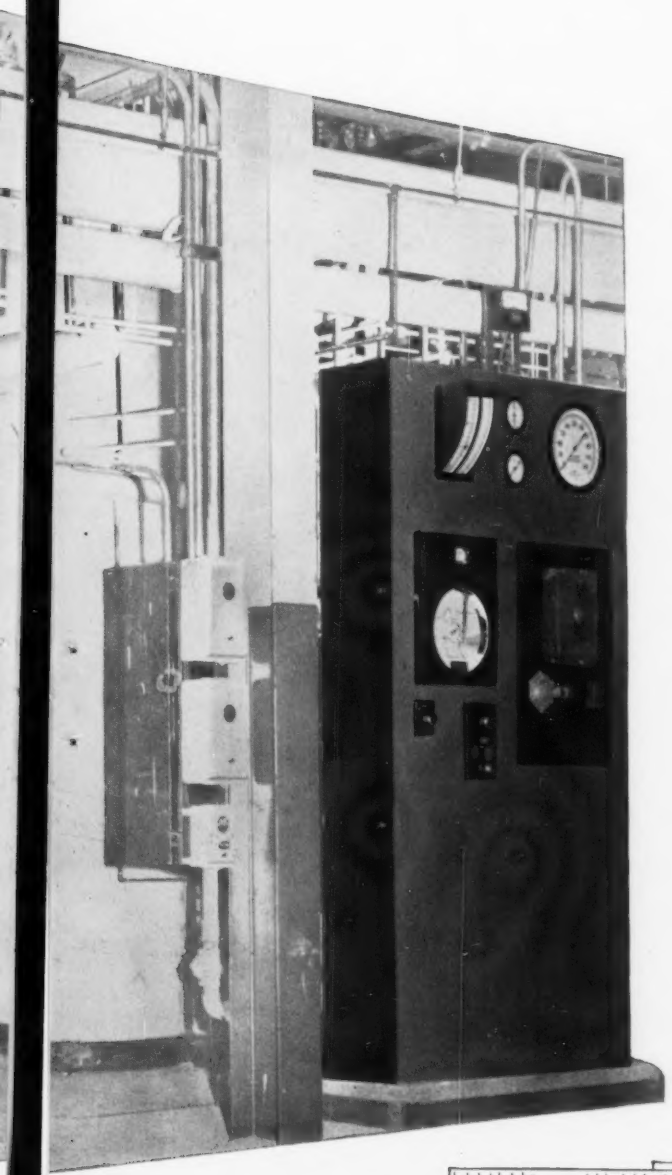
Republic Controls on Package



View of Republic combustion control and instrument panels on each of two gas-fired boilers at the Dallas Love Field Air Terminal. Units incorporate Republic-type VSI 2-unit Draft Indicators and Type EST Boiler Meters with Flue Gas Temperature Pens

Boilers Regulate "Indoor Weather"

...at Dallas' new Love Field Air Terminal



Complete Republic combustion control includes such features as on/off and modulating operation, instrumentation and flame failure control. This type of system operates two 15,000 lbs/hr package boilers, which supply 235 psi steam to centrifugal refrigeration compressors for the Terminal's air conditioning.

Republic's modern control designs are right at home in this $8,000,000 air terminal, which also features such innovations as touch control automatic doors, two-way moving sidewalks and carefully regulated "indoor weather". The new Love Field Air Terminal is truly one of the most modern in America.

Advanced-design combustion controls, based on Republic's experience in plants of all sizes—from package boiler installations to large central station units—are your best guarantee of premium performance from your major equipment. A Republic engineer is ready to help with your instrument and control planning. Republic sales offices are located in principal cities throughout the U.S. and Canada.

REPUBLIC
FLOW METERS CO.

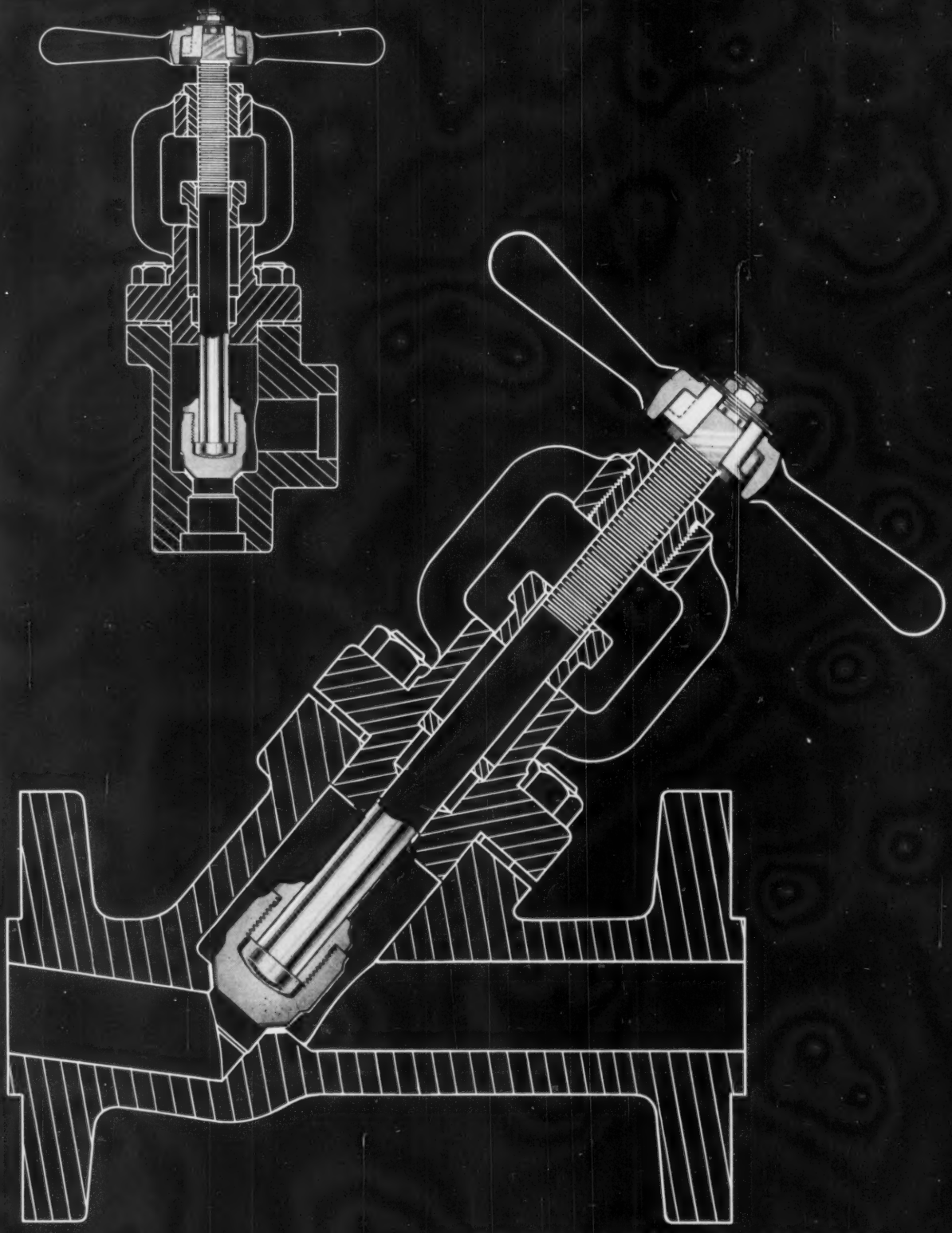
Subsidiary of ROCKWELL MANUFACTURING COMPANY

2240 DIVERSEY PARKWAY • CHICAGO 47, ILL.
In Canada:
REPUBLIC FLOW METERS CANADA, LTD. -TORONTO

Manufacturers of electronic and pneumatic instrument and control systems for utility, process and industrial applications.

DALLAS LOVE FIELD AIR TERMINAL

Associated Architects: Broad & Nelson; Jack Corgan, Dallas
Mechanical Engineers: Zumwalt & Vinther, Dallas
Combustion Controls & Instruments: Republic Flow Meters Co., Chicago



EDWARD FORGED STEEL BLOW-OFF VALVES

What's New from Edward Valves

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

Edward Drop Forged Blow-off Valves

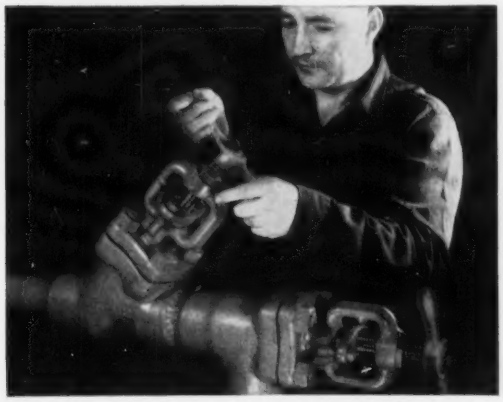
. . . the first—and still the newest!

Fifty years ago, when boilers operated at 250 lb sp the first really efficient means of blowing-down was with "new" Edward blow-off valves. Today, with pressure in the 1800-2600 lb range and with water temperatures sometimes exceeding 600 F, corresponding improvements in Edward blow-off valves have been effected. For example, today all Edward blow-off valves have integral Stellite seats and Impactor* easy closing handles.

All over the world, high temperature-pressure steam power stations rely on these Rockwell-built Edward blow-off valves. The reasons are basic. Edward valves are simple and rugged in design, with no "trick construction." They operate easily, stay tight, need very little maintenance. If parts replacement is ever necessary, repairs are easier and less expensive than with any comparable valve.

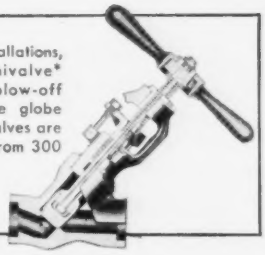
The ASME Power Boiler Code requires steel valves wherever boiler drum pressure is above 200 psi . . . but, because blow-off service is severe at any pressure, operators of lower-pressure plants also have found it most economical to standardize on Edward valves.

Catalog 12-D2 tells the full story.



Recommended practice: Open valve nearer boiler first. Then slowly open other valve. After blow-off, close second valve first; then valve nearer boiler. This places greatest wear on blowing valve, assures a tight valve next to boiler, facilitates repair without a boiler shut-down.

Popular for high pressure installations, the Edward welded-bonnet Univalve* meets Code requirements for blow-off service and is ideal all-purpose globe valve as well. Edward blow-off valves are available in all pressure classes from 300 lb to 2500 lb in angle or straight-way styles, with flanged or welding ends.



Premium Features of Edward Blow-off Valves

- INTEGRAL SEAT of chromium-cobalt-tungsten alloy. Applied directly to body in a continuous ring, then machined in same set-up with bonnet guide bore for perfect alignment. Highly resistant to abrasion and corrosion.
- HARD-FACED DISK—Stellited for maximum resistance to abrasion and corrosion. Edward swivel-disk construction allows stem to lift vertically away from seat. No grinding or galling.
- POSITIVE BACKSEAT isolates packing from the high temperature zone. Line-contact backseat seals EValpak* valve packing from line pressure, permits repacking under pressure.
- IMPACTOR HANDLE, an Edward exclusive, is standard equipment. Several times more effective than ordinary handles or handwheels in opening or closing valves.

EDWARD VALVES, INC.

1230 West 145th Street, East Chicago, Indiana

Subsidiary of

ROCKWELL MANUFACTURING COMPANY

Represented in Canada by

LYTLE ENGINEERING SPECIALTIES, LTD., 360 Notre Dame St. W., Montreal 1, Que.

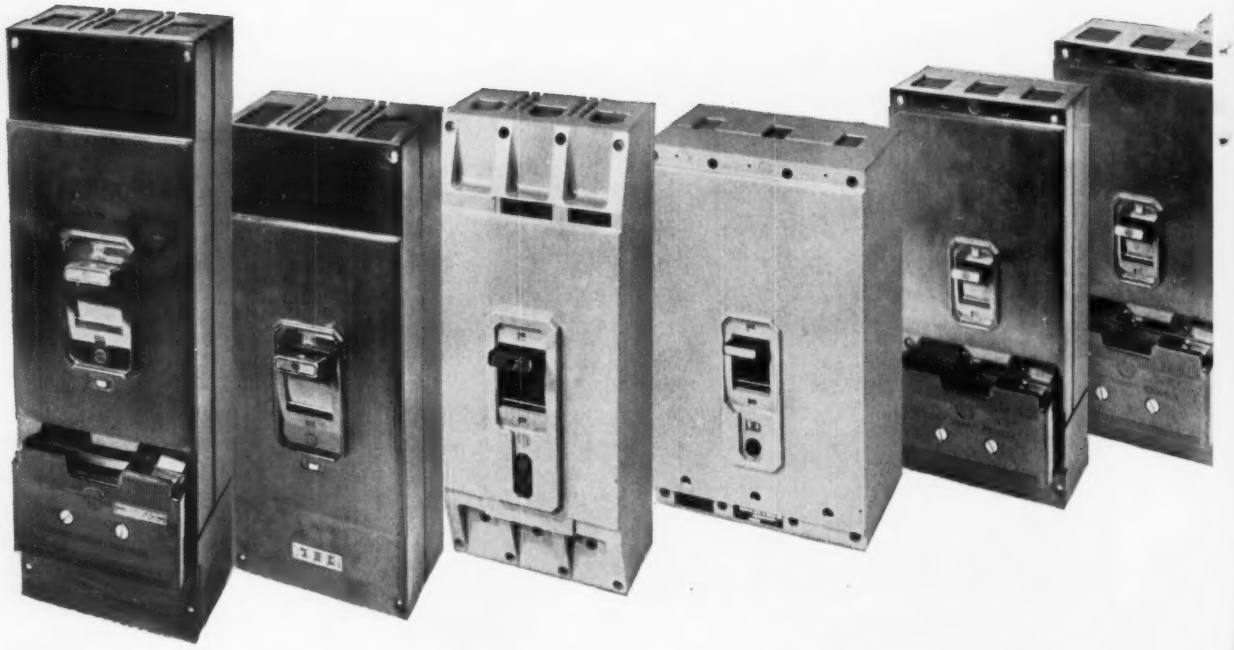
Edward builds a complete line of forged and cast steel valves from ⅛" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends.

*T. M. Reg. U. S. Pat Off.

MOLDED CASE CIRCUIT BREAKERS

YOU GET "EXTRA QUALITY —AT NO EXTRA COST"

in Industry's Most Complete and Diversified Line



From the smallest circuit breakers for lighting circuit protection, through I-T-E's exclusive Cordons—with 100,000 amp interrupting capacities—to the many special-purpose breakers, such as the 400 cycle, 1000 v selective trip breaker designed for Navy use, I-T-E molded case circuit breakers constitute industry's most complete line.

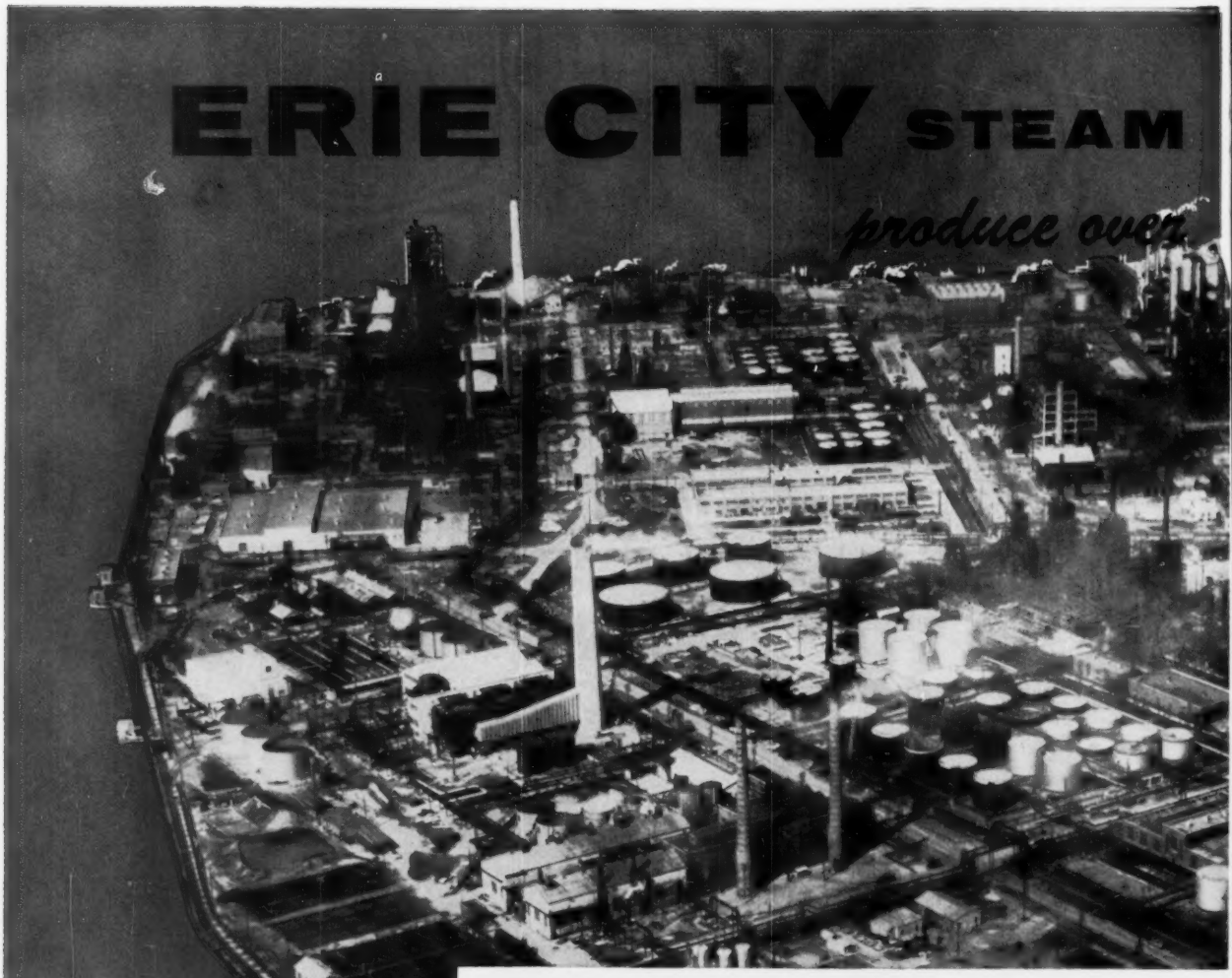
Not only is the I-T-E line the most complete and most diversified, but I-T-E's famed "extra quality—at no extra cost" is built into every product which bears the I-T-E label. And you can depend on the nation-wide network of I-T-E distributors and field engineers to give you second-to-none service. I-T-E Circuit Breaker Co., Small Air Circuit Breaker Division, 19th and Hamilton Streets, Philadelphia 30.

I-T-E CIRCUIT BREAKER COMPANY

PHILADELPHIA, PENNSYLVANIA

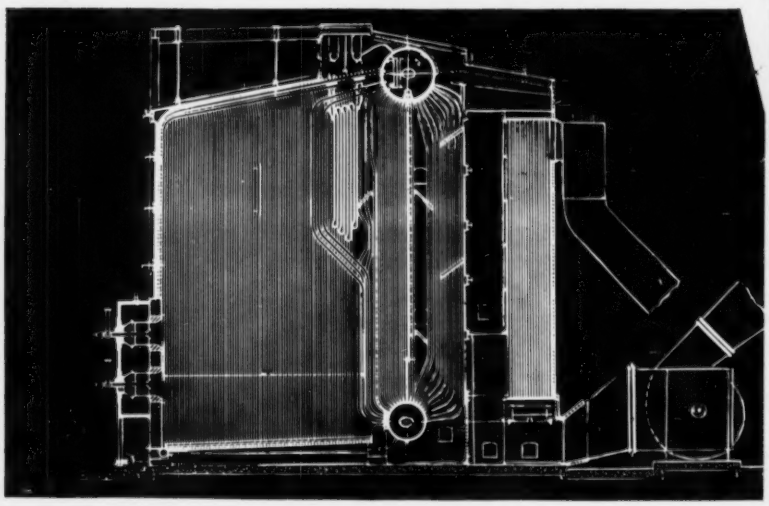
ERIE CITY STEAM

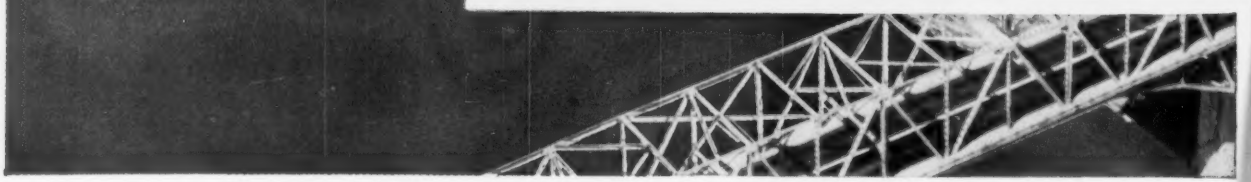
produce over



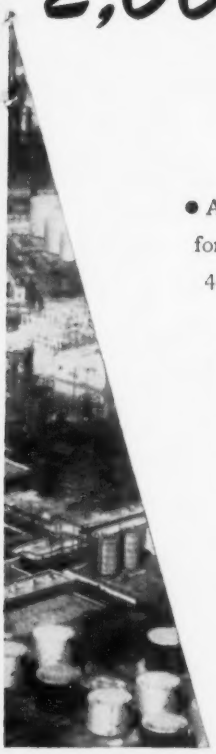
Boiler Data

Boilers	Erie City 2-drum
3	300,000 lbs./hr.
3	400,000 lbs./hr.
Design Pressure	725 lbs.
Operating Pressure	685 lbs.
Total Temperature	688° F.
Firing	Oil and Gas
Superheaters	Erie City
Air Preheaters	Erie City





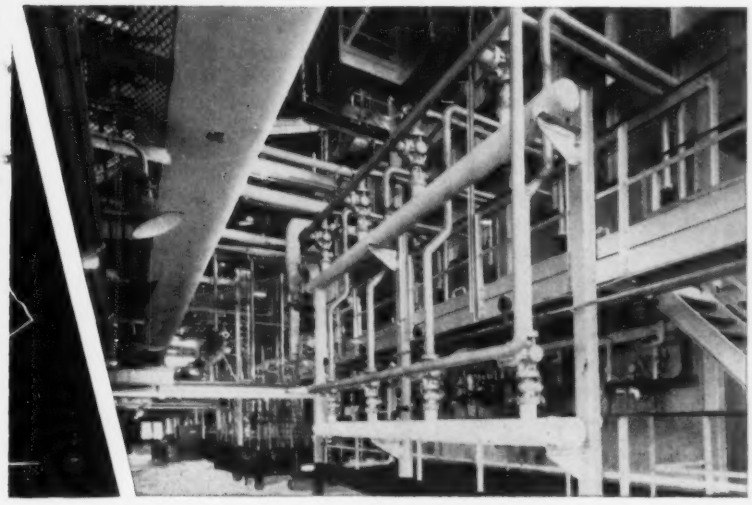
GENERATORS
2,000,000 #/hr. at GULF®
PHILADELPHIA REFINERY



• Another major oil company, Gulf Oil Corporation, liked what they got and came back for more Erie City Steam Generators. In 1951, three 300,000 #/hr. units; in 1953, one 400,000 unit; and in 1956, two 400,000 units — all Erie City 2-drums for outdoor service.

The huge Philadelphia Refinery is an entity unto itself, specifically designed to produce and package Gulf's broad line of high quality petroleum products. Everything about this Gulf operation is tremendous, including some of the world's largest crude Distillation and Catalytic Cracking units. The big Gulf "Cat" alone uses 400,000 lbs. of steam per hour.

Erie City works closely with scores of refineries and petrochemical plants to meet exacting steam specifications. We design and manufacture a complete line of power and waste heat boilers, air heaters, economizers, superheaters, and all types of firing equipment and, therefore, will assume full responsibility for your steam requirements. At no obligation, investigate Erie City for your plant. Write for Catalog SB-5081E.



1951

3—Erie City 300,000 #/hr. Steam Generators

1953

1—Erie City 400,000 #/hr. Steam Generator

1956

2—Erie City 400,000 #/hr. Steam Generators

ERIE CITY Since 1840

You can depend on Erie City for sound engineering

ERIE CITY IRON WORKS • *Erie, Pa.*

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
FIRE AND WATER TUBE PACKAGE BOILERS • WASTE HEAT BOILERS
OIL AND GAS BURNERS • STOKERS • PULVERIZERS

What are your needs for

YARWAY COLOR-PORT WATER LEVEL GAGE

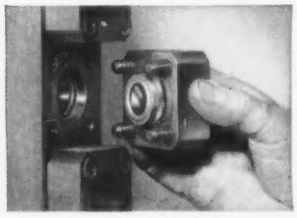
two-color readings
low maintenance
increased availability

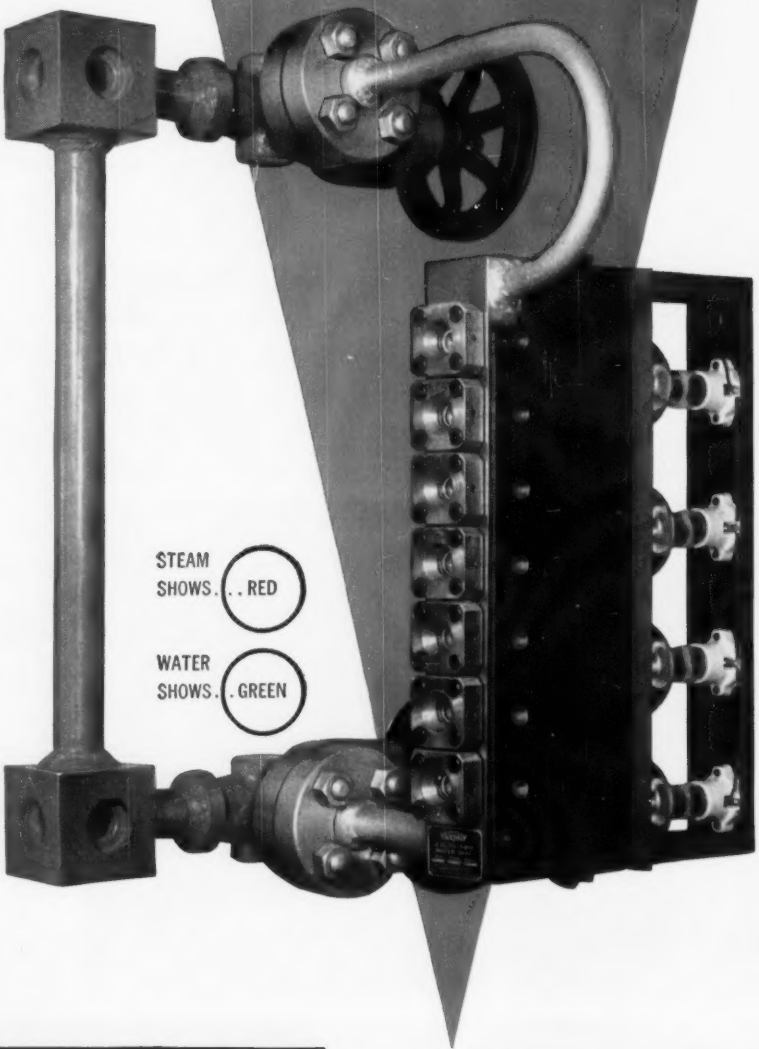
You get a *triple advantage* with the Yarway COLOR-PORT boiler water level gage for pressures to 3000 psi.

Two-color readings are brilliant and clear. Water shows green; steam shows red. A full gage is all green and an empty gage all red.

Low maintenance with individual cover-glass assemblies, each held solidly in place by four socket head cap screws. "Floating assembly" design applies safe, predetermined loads on glass ports, reducing thermal shocks, permitting faster warm-up.

Increased availability means longer service life. Cover glass assemblies can be *serviced in place*, easily and quickly.





Yarway Bulletin WG-1814 describes the Color-Port Gage. Write for it.

YARNALL-WARING COMPANY
100 Mermaid Avenue
Philadelphia 18, Pa.
Branch Offices in Principal Cities

YARWAY COLOR-PORT

. . . a good way to specify high pressure water gages

boiler water level indication ?

YARWAY REMOTE LIQUID LEVEL INDICATORS

Boiler water levels and other liquid levels requiring remote indication can be handled completely by a Yarway system

Heart of the system is the Yarway Remote Liquid Level Indicator that gives instant, accurate readings because the mechanism is operated by the boiler water or other liquid itself. The pointer mechanism is never under pressure. Clear, "wide vision" face permits easy readings from any angle

The Yarway Indicator conforms with A.S.M.E. Boiler Code Committee ruling (Case #1155) permitting two independent remote level indicators of compensated manometric type to replace one of two required gage glasses for boiler pressures 900 psi and above.

Electronic Secondary Indicators can be added at any point in the plant. Remote Hi-Lo Alarm Signals (lights and/or horns) can be connected for additional safety.

Primary indicators fully compensated for every pressure change in boiler also available.

For permanent record of changing levels, the Yarway Hi-Lo-Graph Recorder can be furnished.

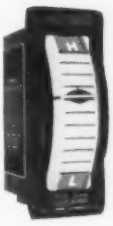
Over 10,000 Yarway Remote Indicators have already been installed. For full details, write for Yarway Bulletin WG-1824.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

FULLY COMPENSATED INDICATORS

for completely accurate indication under every boiler operating condition

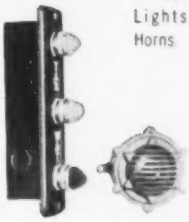
ELECTRONIC SECONDARY INDICATORS



To supply additional indication at any point without pressure connections.

REMOTE SIGNALS

Hi-Lo Alarms Lights and/or Horns

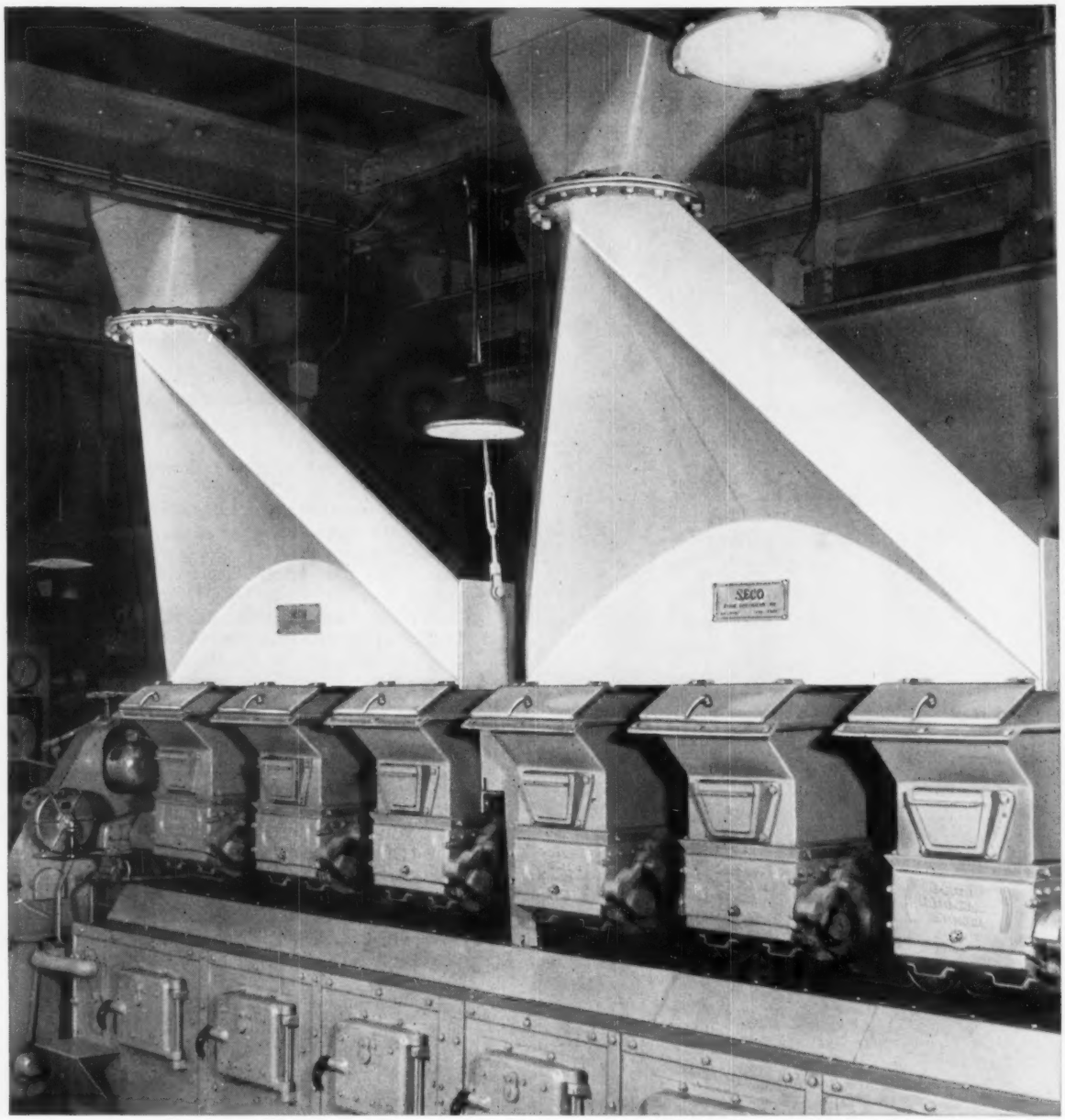


RECORDERS

To provide permanent 24-hour record of liquid levels.

YARWAY

. . . a good way to specify remote liquid level indicators



THERE'S no substitute for a S-E-Co. CONICAL Coal Distributor — it's truly non-segregating. You can rely on Stock Equipment Company's attention to details of design, layout, and fabrication, backed by years of specializing in this field. Be sure the distributor you buy will do the job it's supposed to do — help your stokers operate more efficiently and economically. Get a S-E-Co. CONICAL Non-Segregating Coal Distributor.

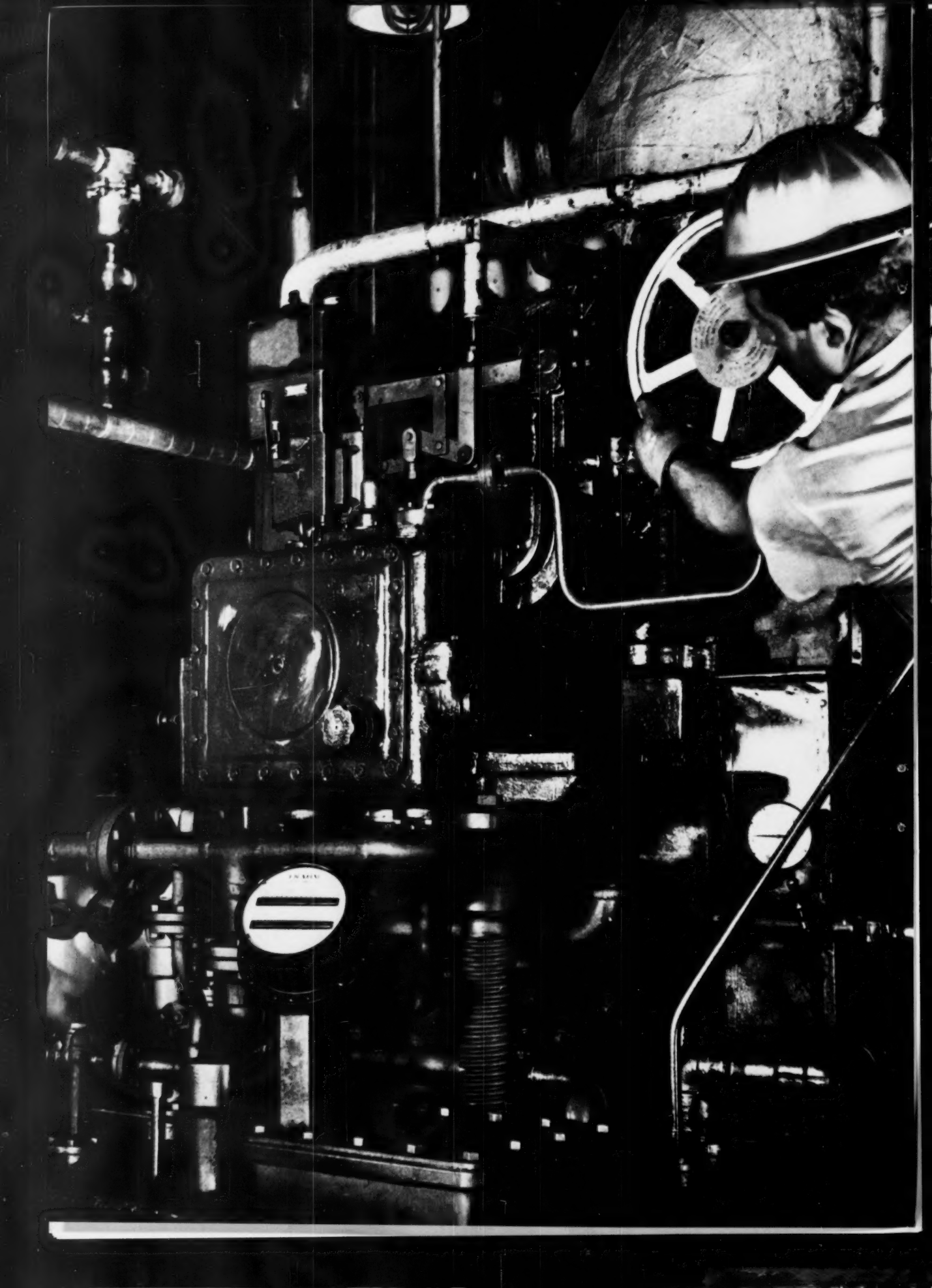
Manufacturers of S-E-Co. Coal Scales, Coal Valves, Coal Stoppage Alarms, CONICAL Distributors, and Underbunker Conveyors.

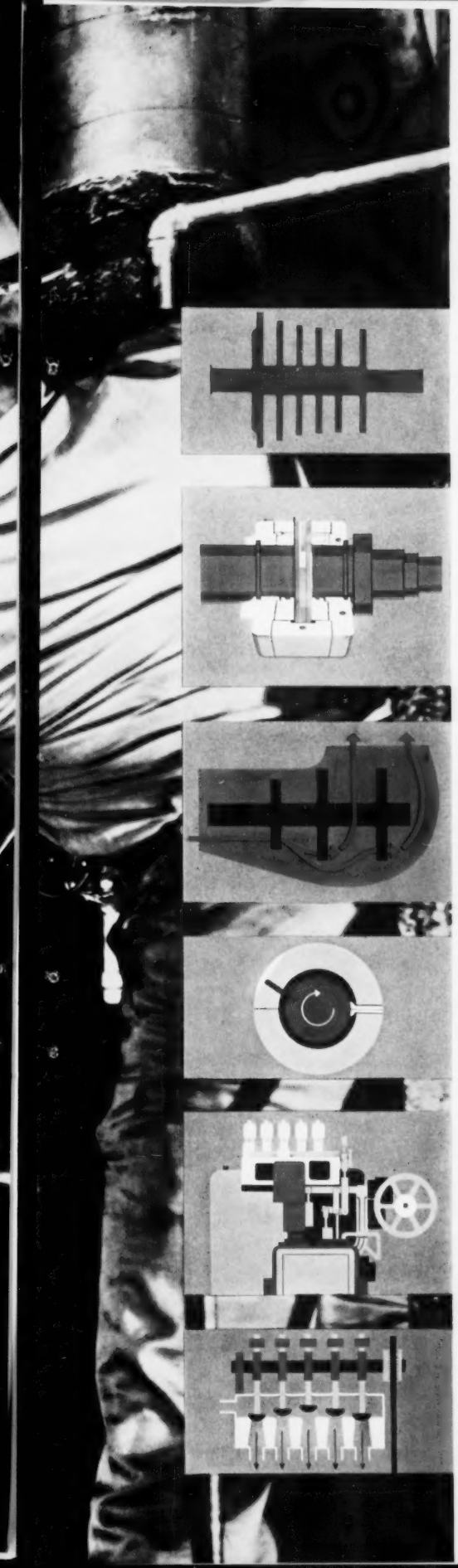
STOCK Equipment Company

745-P HANNA BLDG., CLEVELAND 15, OHIO

HOW TO SAVE MONEY BY SPENDING IT!

PAY EXTRA NOW FOR
6 BASIC RELIABILITY FEATURES OF
WORTHINGTON HIGH-SPEED TURBINES
AND AVOID THE EXCESSIVE COSTS
OF DOWN-TIME LATER





Worthington High-Speed Turbines cost more to build, are used more, are worth more

(these 6 reliability facts are some of the reasons why)

Reliability Fact #1

SOLID ROTORS keep wheel stresses well within safety margins. Where needed, wheels forged integral with the shaft are used to meet the demands of modern high speeds. Solid rotor construction, a sure method of holding wheels on the shaft, provides a more rugged conservative design. Solid rotor also decreases length of turbine, thus simplifying critical speed problems and adding to efficiency.

Reliability Fact #2

KINGSBURY-TYPE THRUST BEARINGS withstand heavy thrust loads with small friction loss and low rate of wear. Bearings have babbitted surfaced multi-segment shoes that pivot on hardened buttons. This pivoting action forms a wedge-shaped oil film between the rotating thrust collar and the shoe bearing surface. This has a cushioning effect in case of unusual shock loads in either direction. The thrust load is automatically distributed equally to the several shoes thereby maintaining internal alignment as well as holding the rotor in its axial position.

Reliability Fact #3

DOUBLE-FLOW exhaust construction on Worthington turbines reduces operating stress and increases efficiency in the handling of large volumes of steam at high speeds. Steam is divided ahead of the last stage and directed through separate rows of revolving blades before leaving via a common exhaust. Double-flow exhaust construction allows reduction in last-stage wheel size and blade length, which reduces wheel and blade stress and makes possible a simplified blade design. This permits improved nozzling with consequent efficiency increase.

Reliability Fact #4

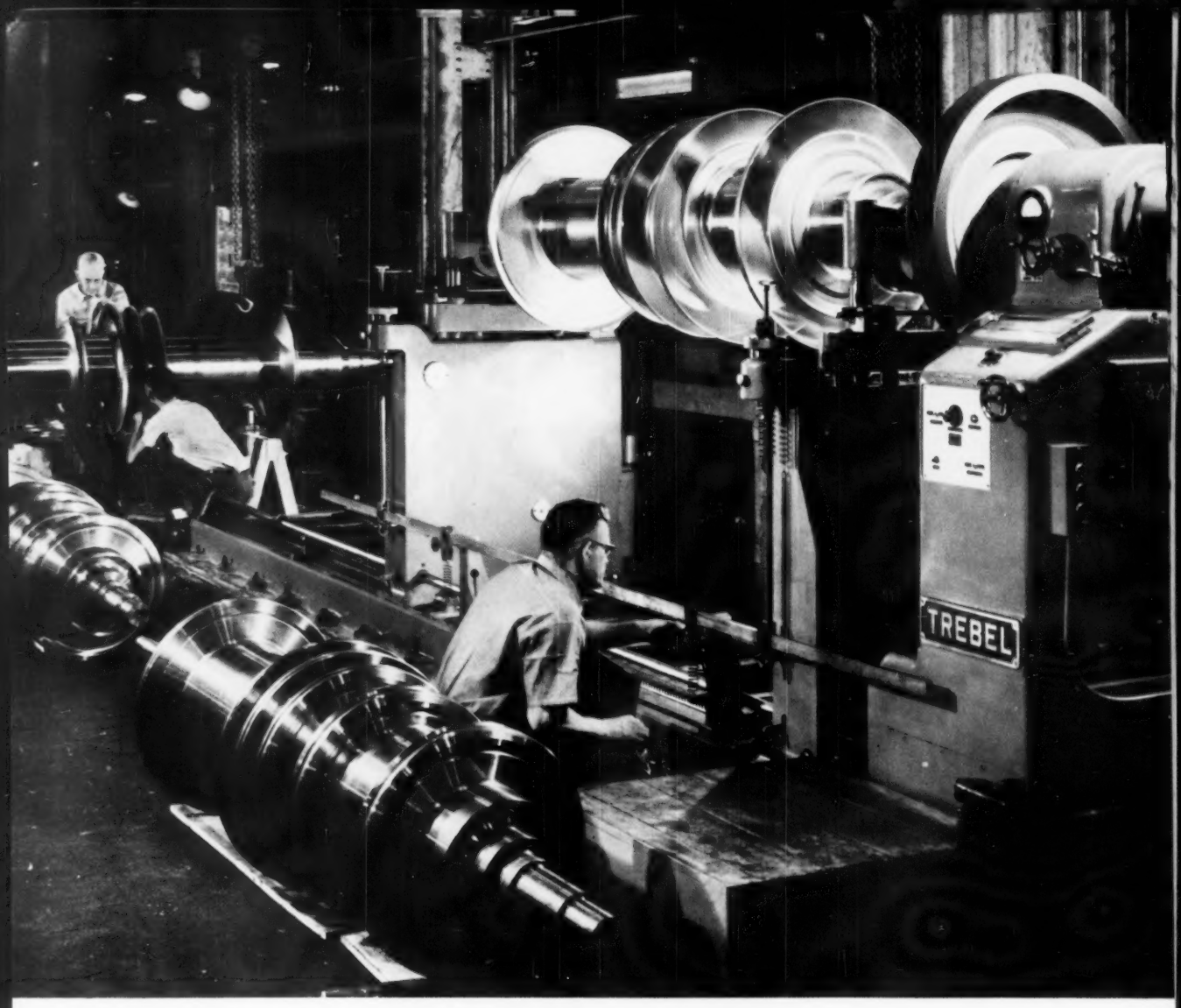
ANTI-OIL-WHIP BEARINGS are standard on Worthington high-speed turbines. A dam in the upper half of the bearing builds up a pressure pad of oil during operation. The pressure creates a downward force on the journal holding it firm in the bearing, thus keeping vibration to a minimum. Anti-oil-whip design increases life, cuts maintenance expense on bearings.

Reliability Fact #5

SENSITIVE SPEED GOVERNING SYSTEM with integral air motor combines extremely close regulation with a broad range of speed adjustment. Governor takes air impulses from an outside controller to vary speed of turbine in accordance with controller's impulse. Sensitive governor is capable of maintaining the output from the compressor substantially constant. Regardless of changes in load or steam conditions, the turbine is always under control of the speed governor, governing at any speed for which the air motor is set.

Reliability Fact #6

MULTI-VALVE AUTOMATIC NOZZLE CONTROL assures most economical operation of the turbine at all loads. Each valve automatically controls the admission of steam to a separate group of nozzles, and is operated by an independent cam mounted on a camshaft. The cams are shaped to give any desired rate of opening. The entire mechanism is mechanical, positive, and far superior to other lower-cost designs.



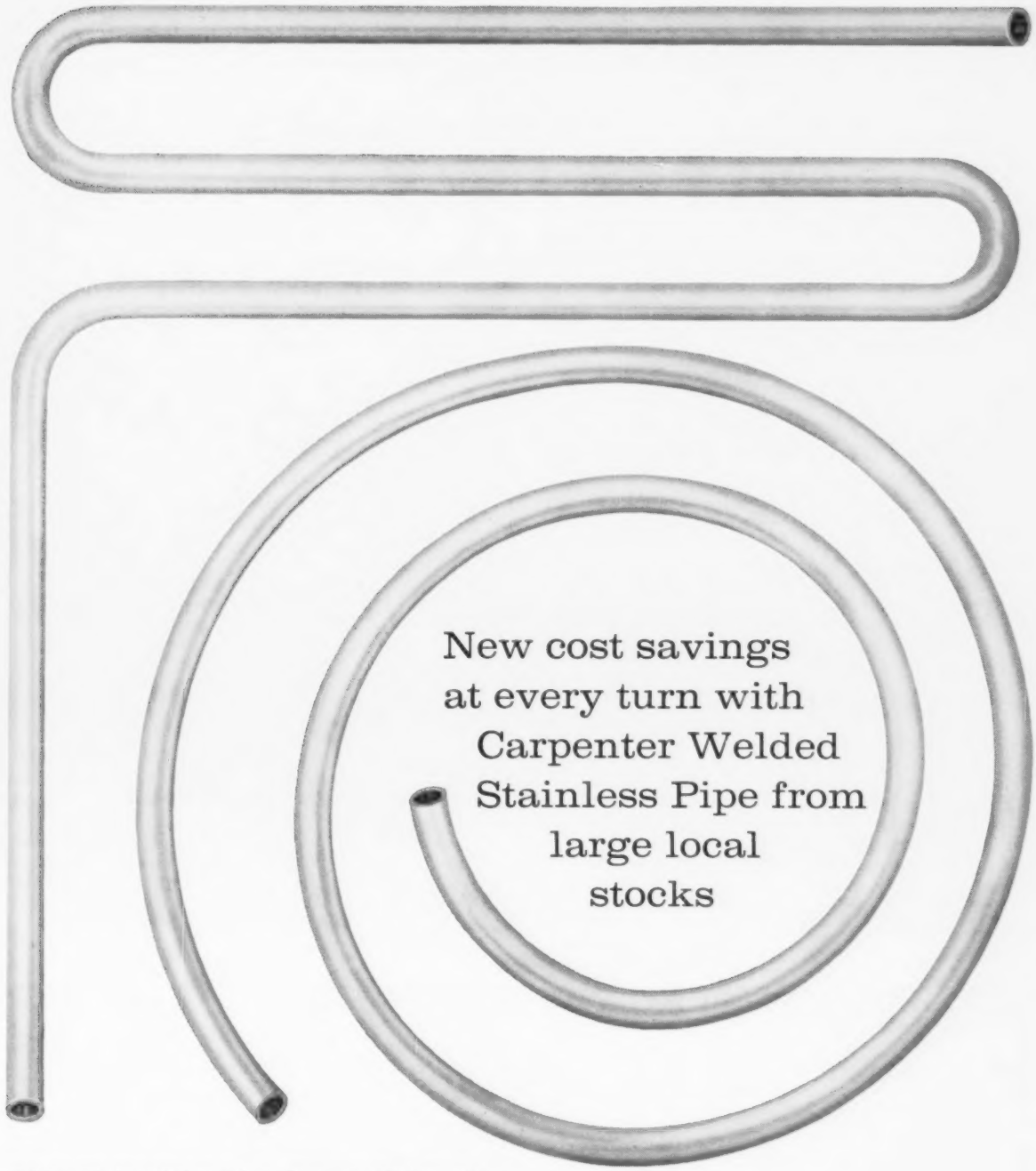
Balancing rotor for a 6,000 hp Worthington high-speed turbine.

THE MEANING OF LEADERSHIP

Long, trouble-free life of Worthington high-speed turbines stems from two primary sources. One: the multiple achievements of Worthington engineers. Two: the wide variety of tests to which machines are subjected before shipment to customer. Worthington, for example, is the only manufacturer that load-tests all multi-stage turbines. In this process, the turbine is coupled to a water brake so that its precise behavior under actual performance conditions can be predicted. Only when the turbine has passed this — and many other exacting tests — is it approved for shipment. This infinite attention to detail, this painstaking insistence upon perfection, explains why Worthington is today the nation's undisputed leader in high-speed turbine installations. 48-2

WORTHINGTON

WORTHINGTON CORPORATION, HARRISON, NEW JERSEY

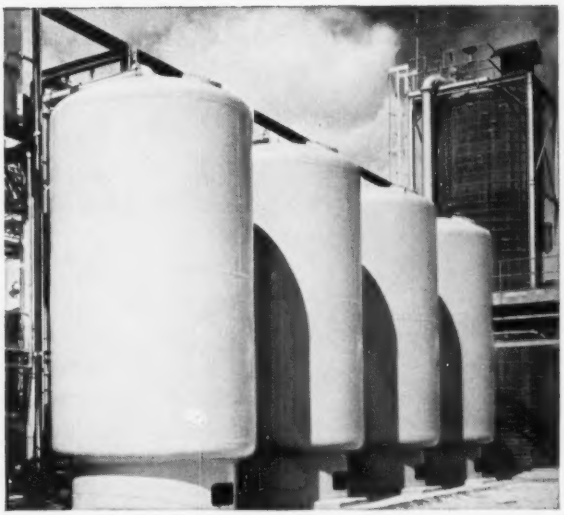


● Not only in initial cost does Carpenter Stainless Pipe save you money. Every step from installation through extra long service life will show Carpenter's superiority. The uniformity of Carpenter welded stainless pipe adds even more operational benefits no matter which schedule you select . . . 5, 10 or 40. Carpenter makes all three. Your local distributor can supply your needs from stock. He can give you fast delivery. For complete ordering information write for Carpenter's Selecting and Buying Guide. The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

Carpenter

Stainless Pipe

ENGINEERING. Permutit engineers work with your staff or your consulting engineers to design all or any part of your water conditioning system.



EQUIPMENT. Permutit supplies complete equipment. Critical parts such as valves, chemical feeders and controls are designed and made by Permutit.

How Permutit® Solves a Water Problem

U. S. industry is faced with using lower grade water. Results: possible boiler scale, turbine deposits, corrosion of pumps and piping . . . also stains, blisters and other problems in plating, rinsing, dyeing and chemical processing.

• **For expert answers,** more and more management men and their consultants are buying the complete service offered by leading water-conditioning firms. Here's how Permutit (rhymes with "compute it"), a pioneer and largest in the field, tackles a water problem:

• **Water analysis,** study of the problem and past experience provide data on possible methods of treatment. The process offering the best balance of initial and operating cost vs desired quality of treated water is selected.

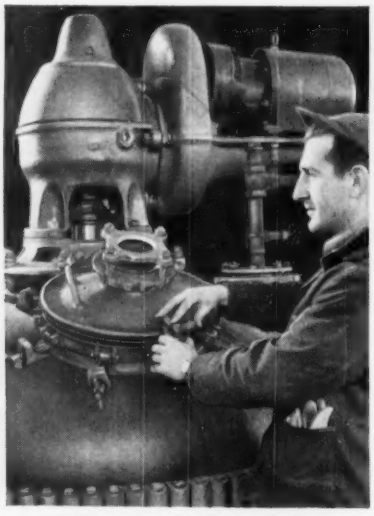
• **Complete proposal** by Permutit engineers covers type, size and capacity of equipment, price, any special engineering services and guarantees.

• **Manufacturing**—After the proposal is accepted, Permutit designs the entire project, schedules assembly and shipping. Critical parts, ion exchange resins, control panels are all made in Permutit plants. (No other U. S. firm makes all these components.)

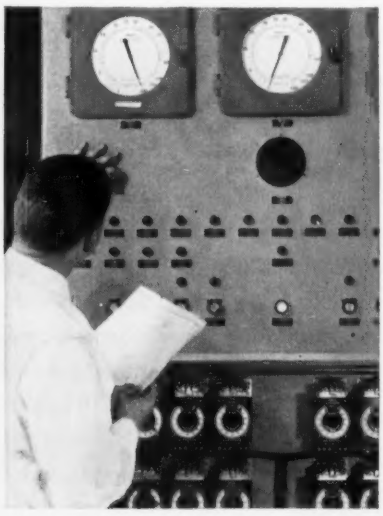
• **Test runs**—Where required, Permutit checks the installation, supervises start-up and initial operation, trains permanent operating personnel.

• **For further information** look up the Permutit office in your city or write to The Permutit Company, a division of Pfaudler Permutit Inc., Dept. P-5, 50 West 44th St., New York 36, N. Y.

WATER ANALYSIS. Permutit's modern water-analysis laboratory tests over 1200 samples a month!



ION EXCHANGE RESINS. Permutit makes its own ion exchange resins, natural and synthetic zeolites.



AUTOMATIC CONTROLS to ensure optimum results are designed, assembled, wired and tested by Permutit.

BRANCHES

BALTIMORE, MD.	MILWAUKEE, WIS.
BOSTON, MASS.	MINNEAPOLIS, MINN.
BUFFALO, N. Y.	MONTREAL, CANADA
CINCINNATI, OHIO	NEW ORLEANS, LA.
CHICAGO, ILL.	NEW YORK, N. Y.
CLEVELAND, OHIO	PHILADELPHIA, PA.
DAYTON, OHIO	PITTSBURGH, PA.
DETROIT, MICH.	SAN FRANCISCO, CAL.
HOUSTON, TEX.	SEATTLE, WASH.
INDIANAPOLIS, IND.	ST. LOUIS, MO.
LOS ANGELES, CAL.	TOLEDO, OHIO
WILMINGTON, CAL.	

ANCHOR INDUSTRIAL FACINGS stay POWERFUL

through long service life . . .

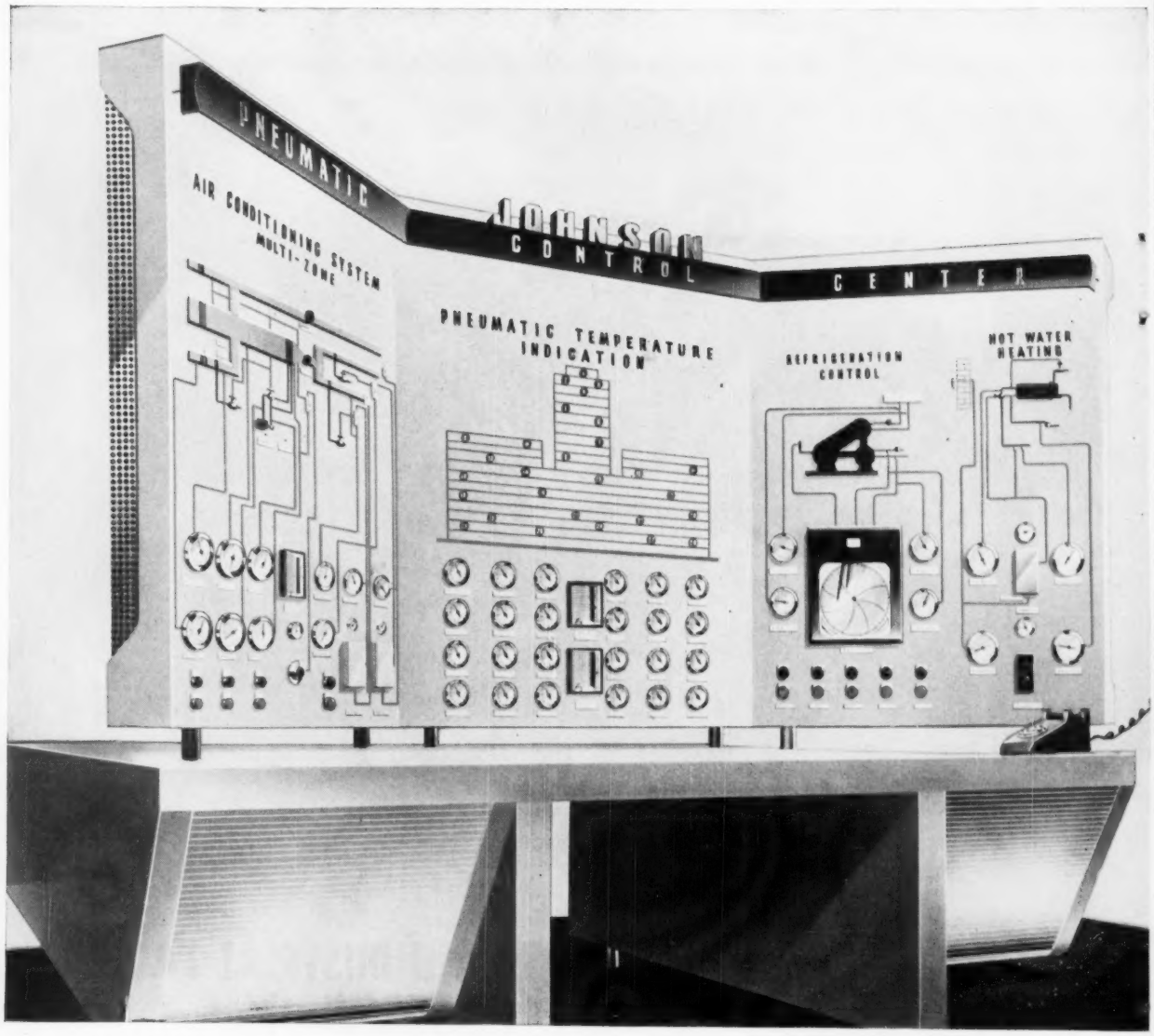
The dense, wear-resistant structure is made of special asbestos material combinations developed for the purpose. The facings are molded to required dimensions under heat and tremendous hydraulic pressure.

On applications for which they are recommended, these clutch facings are unchallenged leaders. They are available in types and sizes for most industrial service.

THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.
FACTORIES: MANHEIM, PA. ELKHART, IND. MONTREAL, CAN.

FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE



Add the Final Touch of Magic

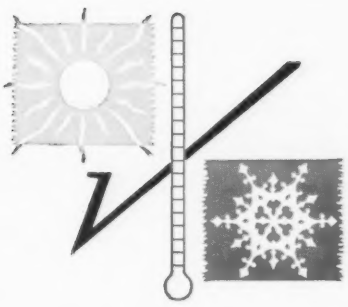
JOHNSON PNEUMATIC CONTROL CENTERS

Perfection of the Pneumatic Control Center by Johnson is bringing major savings in heating and cooling costs as well as greatly improved temperature control to buildings of all types and sizes.

The Johnson Pneumatic Control Center gives the building engineer *centralized* supervision and regulation of the air conditioning and heating system. It provides him with a *continuous*, comprehensive visual display of all the vital operating data necessary to maintain the exact temperature conditions required. Simultaneously, it assures that all components of the system constantly function at peak efficiency.

A GLANCE TELLS ALL

By simply scanning the panel, for example, the operator can check space temperatures and water and air supply temperatures at strategic control points throughout the system. *Equally important, he can make any necessary adjustments of key temperatures instantly, right at the panel!*



Sizes, layouts and styles of Johnson Pneumatic Control Centers depend upon the specialized needs of the individual building. Each is planned separately with the building's engineer and architect.

to Your Air Conditioning!

ONE MAN DOES EVERYTHING

Thus, the operation of even the most complex air conditioning and heating systems is reduced to a one-man job! Instead of an operating *crew* checking performance and making adjustments at widely scattered locations, one man does it all from the panel! In effect, he can be in 20 or 30 or more places at once!

This coordinated, unerring control assures a uniformly ideal environment to meet every comfort or process requirement of any modern building. It results in large reductions in fuel and power consumption and prolongs equipment life.

Remarkably easy to understand and operate, the Pneumatic Control Center requires no extensive study or training. Its components are as simple and inexpensive to use and maintain as the pneumatic controls used elsewhere in the building. Dramatic styling adds an exciting architectural asset when the Center is located in public view.

ECONOMIC ADVANTAGES IMPRESSIVE

What the Pneumatic Control Center means in terms of manpower savings, more efficient heating and air conditioning performance and greater comfort is obvious. It not only pays for itself in a hurry, but it keeps right on paying off over the life of the building!

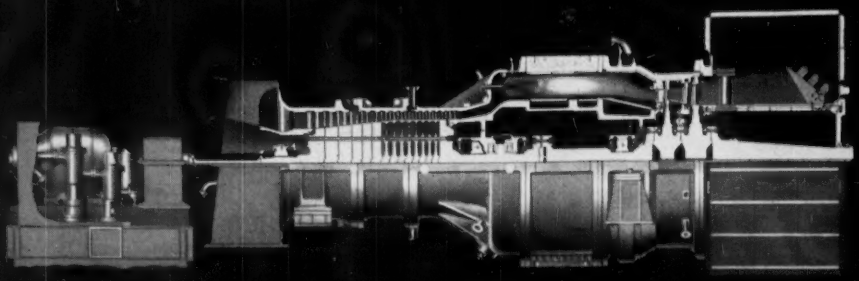
Pace-setting Johnson Pneumatic Temperature Control Systems with Control Centers are now being installed in many of the nation's finest industrial plants, offices, stores, hotels, hospitals, schools and public buildings. Before you build or modernize, ask your local Johnson branch for full details or write Johnson Service Company, Milwaukee 1, Wisconsin.

JOHNSON CONTROL

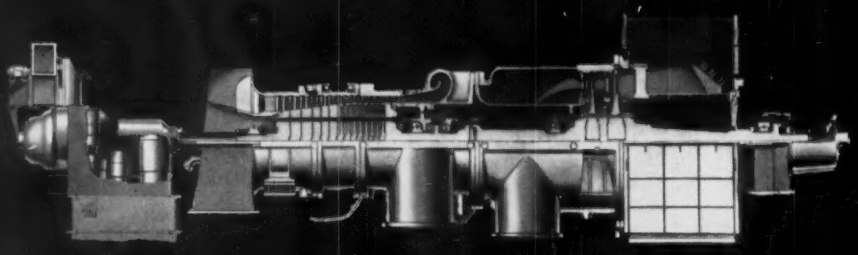
PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

SIMPLE-CYCLE
16,500 KW, 22,500 HP

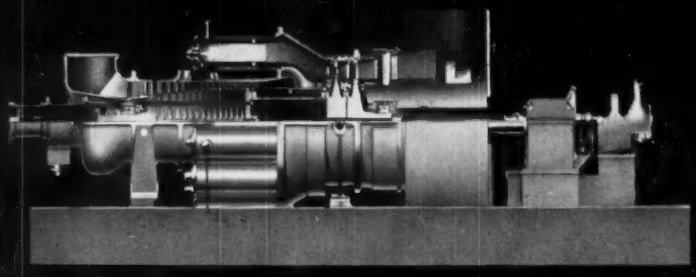


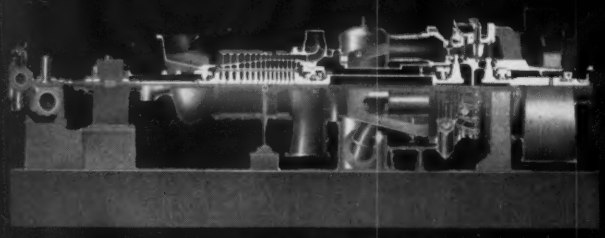
General Electric Gas Turbines Log..



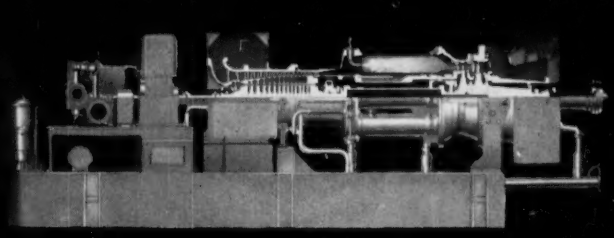
REGENERATIVE-CYCLE
15,200 KW; 20,900 HP

SIMPLE-CYCLE
9,500 KW; 13,400 HP

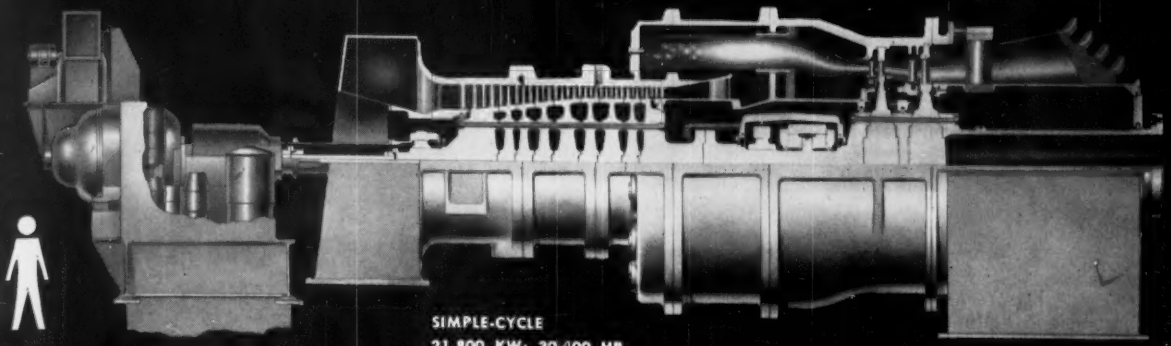




REGENERATIVE-CYCLE
5,400 KW; 7,600 HP



SIMPLE-CYCLE
5,300 KW; 7,500 HP



SIMPLE-CYCLE
21,800 KW; 30,400 HP

OPERATING EXPERIENCE, WIDE RANGE OF RATINGS OFFER NEW OPPORTUNITIES FOR INCREASING USE

Over 2,250,000 Operating Hours

Over two-and-a-quarter-million operating hours recorded by 135 units in a wide variety of applications—this is the unduplicated performance record that has established General Electric gas turbines as increasingly important powermakers.

APPLICATION VERSATILITY is one of the primary reasons for wide gas turbine acceptance. By providing power, exhaust heat, or combustion air for use in process or in combination with steam turbines, these self-contained prime movers are able to satisfy a variety of power requirements. A brief look at the chart on this page shows the varied industries using General Electric gas turbines.

A BROAD RANGE OF RATINGS is now available. Units range from 6,700 to 30,400 horsepower and 4,750 to 21,800 kilowatts. Because gas turbines are more compact than conventional power plants, building requirements are simple and limited space is required.

Proven by operating experience, versatile General Electric gas turbines stand ready—now—for even broader application. Whatever your power, heat or process requirements are, why not get all the facts on this important power plant. For more information, contact your nearest General Electric Apparatus Sales Office or write for GED-3546 (Gas Turbines for Industry), or GED-3603 (Gas Turbines for Electric Utilities), General Electric Company, Section 261-31, Schenectady 5, N. Y.

GENERAL ELECTRIC GAS TURBINES POST IMPRESSIVE OPERATING RECORDS IN DIVERSE APPLICATIONS

APPLICATIONS	NUMBER OF UNITS*	TOTAL EQUIVALENT HORSEPOWER*	OPERATING HOURS
GAS AND OIL PIPELINE	88	574,800	1,185,000
LOCOMOTIVE DRIVE	58	462,890	500,000
ELECTRIC UTILITY	31	348,200	200,000
PETROLEUM AND CHEMICAL	20	191,450	50,000
OIL FIELD	16	155,400	300,000
GENERAL INDUSTRIAL (steel, rubber, paper)	5	76,200	10,000
MARINE AND NAVY	2	10,600	5,000
TOTAL	220	1,819,540	2,250,000

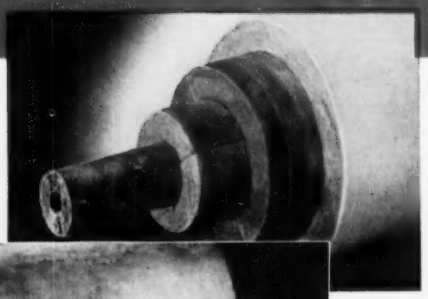
*General Electric gas turbines installed and on order as of February, 1958.

Progress Is Our Most Important Product

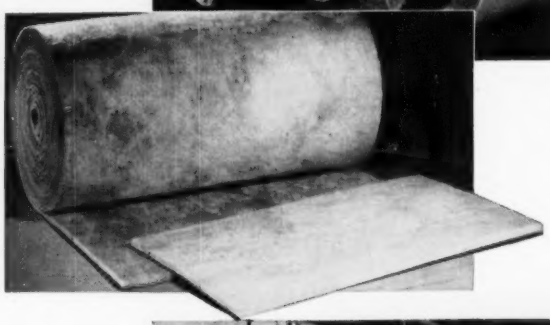
GENERAL ELECTRIC

NOW with SUPERGLAS

EAGLE-PICHER has a FULL LINE of *Industrial and Commercial* INSULATIONS

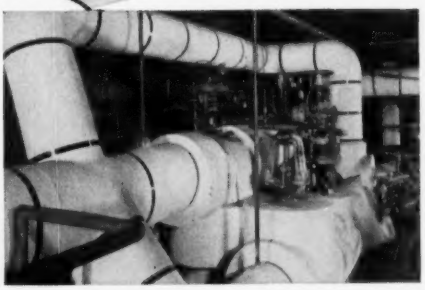


No matter what the application, there's now an Eagle-Picher insulation to do the job best. Choose the basic material you prefer—mineral wool, magnesia or Eagle-Picher's latest, SUPERGLAS. These materials give you a complete choice of pipe insulations, blocks, blankets, felts and cements.



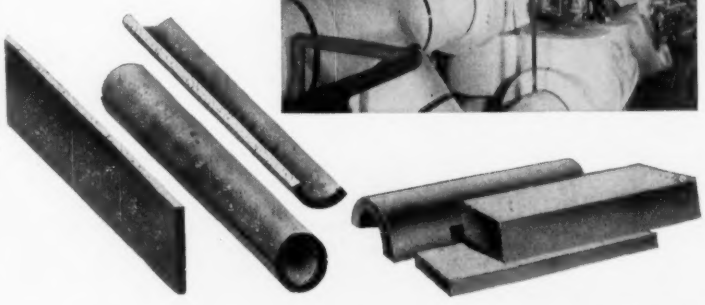
Superglas Insulations

Have low bulk, low application costs, few maintenance problems. Won't shrink, warp or buckle. Available in a wide variety of shapes, types, sizes, thicknesses and densities for pipe, duct and equipment installations. Effective at temperatures from minus 120 F to 400 F. Numerous finishes and facings for pleasing appearance in exposed installations.



85% Magnesia and Hylo Insulations

Extremely light weight with low conductivity, great strength and high dimensional stability. Easily workable, retains high thermal efficiency. Available in pipe section and blocks.



Mineral Wool Insulations

These mineral wool and cement insulations provide maximum thermal efficiency for temperatures ranging from below zero to over 2000 F.

PV SUPERTEMP BLOCKS — an all purpose, true-cut block with *precision finish.* Combines efficiency, durability and great strength. Lightweight, easily installed, resists steam and other moisture.

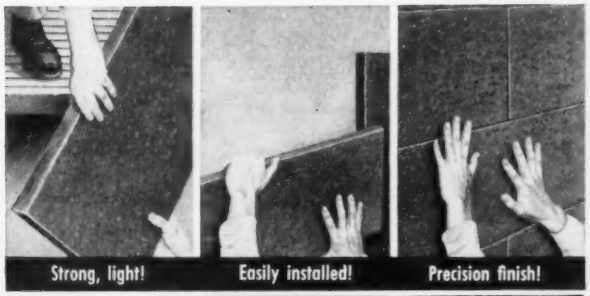
BLANKETS—factory fabricated to *rigid specifications.* Blankets are completely free of large voids. Smooth edges butt tightly together. For application to flat or slightly curved surfaces, can be cut to fit irregular areas.

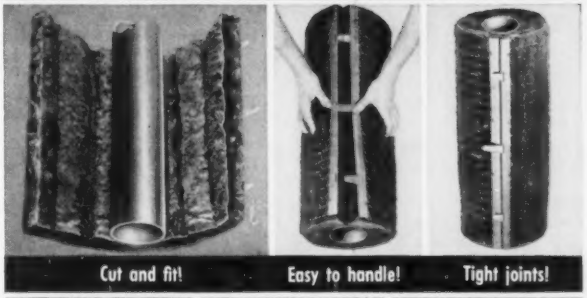
TAB-LOK—a high temperature pipe insulation *easy to apply.* Precision made, tab-and-slot feature assures tight, close butted joints. Water-repellent, corrosion, fire, and vibration-resistant. No reinforcing needed. Saves time and labor.

SUPER "66" CEMENT—*sticks to hot or cold surfaces.* Makes difficult jobs easy. Maximum coverage with no reinforcing needed on applications up to 1½ inches thick. Special rust inhibitor prevents corrosion.

ONE-COTE CEMENT—one quick application *insulates, protects, finishes.* Clean, easy to handle. For indoor or outdoor application. Applied to hot or cold surfaces. Quick setting, resists rain and moisture two hours after application. Prevents rust.

We will be glad to send you complete data on our comprehensive line of insulations for all industrial and commercial applications. WRITE TODAY!



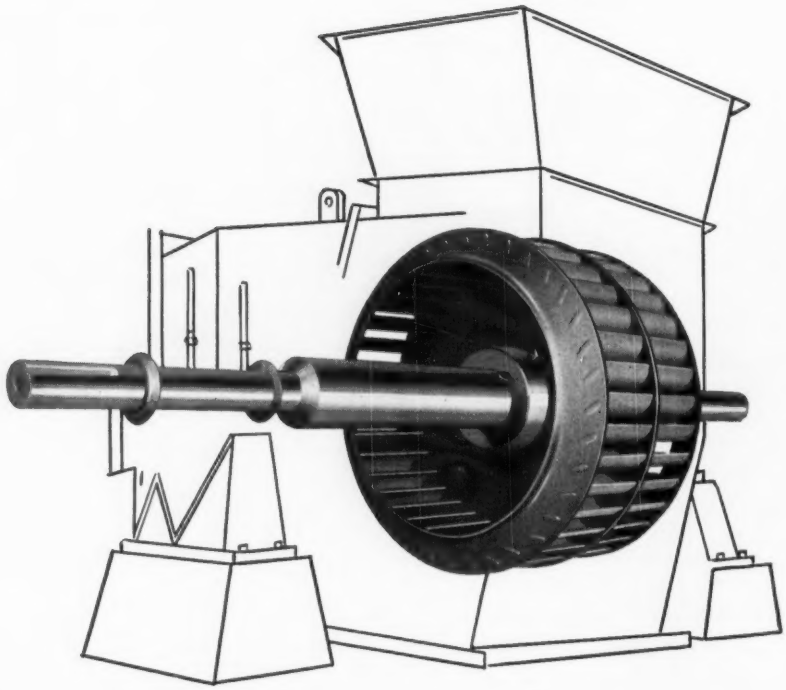


Since 1843

EAGLE PICHER

EAGLE-PICHER

The Eagle-Picher Company
General Offices: Cincinnati 1, Ohio



CLARAGE TYPE DN DYNACURVE FAN OFFERS A

New Concept

IN INDUCED DRAFT WHEEL DESIGN

36 radially deep, aerodynamically curved blades impart a dynamic energy to the gas stream to achieve low tip speed operation.

Unique shape of the blades and rims minimizes shock losses and turbulence at the entering edge of the blades and between the blades.

Wheel design assures relatively low moment of inertia (WR^2).

Wheel is constructed with a heavy forged steel hub and a sturdy centerplate.

All welded construction of the wheel provides ample shear strength, tensile strength, and rigidity.

These are only a few of the features that make Clarage's new Type DN Dynacurve Fans fully equal to the most punishing demands.

Write today for Bulletin 905. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

Want Control for
Water Heaters • Processes
Heat Exchangers • Compressors
Diesel and Gas Engines?

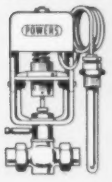
call POWERS

FLOWRITE®
One of Powers Premium Quality Diaphragm Control Valves. They're simple, sturdy and dependable.

Over 60 Years of Temperature and Humidity Control

(c28r)

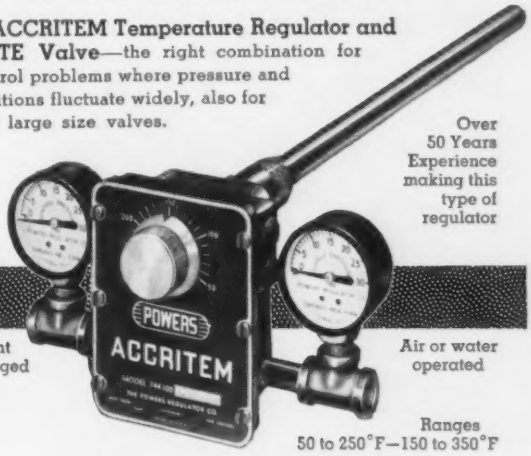
You Will Insure Better Temperature Control IF—



you use the right type regulator and proper size control valve. Whether you require a self-operating regulator shown at left or the ACCRITEM featured here . . . you can get them both and other types from Powers.

Use our 65 YEARS of Experience and engineering know-how to help you select the right type of control. Call our nearest office or write us direct.

Powers ACCRITEM Temperature Regulator and FLOWRITE Valve—the right combination for many control problems where pressure and load conditions fluctuate widely, also for control of large size valves.



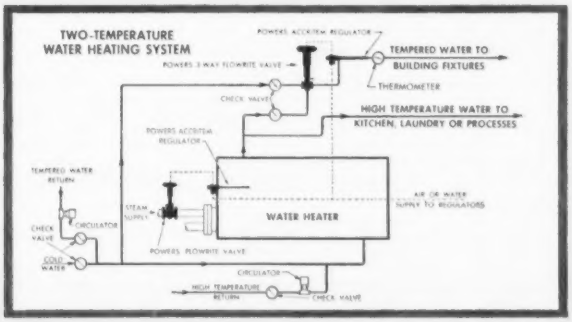
Over 50 Years Experience making this type of regulator

Control Point easily changed

Air or water operated

Ranges 50 to 250°F—150 to 350°F

VALVES: Available in a variety of body types and inner valves.

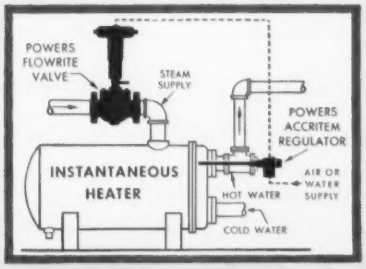


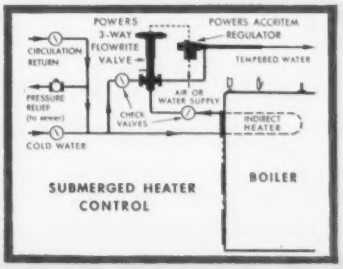
ACCRITEM® TEMPERATURE REGULATOR

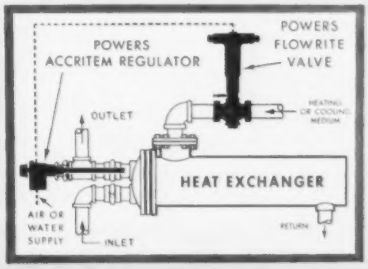
Gives Close Control and Years of Dependable Service.

- Has Adjustable Throttling Range and Calibrated Dial.
- Simple, Durable Construction assures years of trouble-free service.
- Easy to Install • Direct or Reverse Acting, reversible on the job.
- Small Size: Regulator head is 2⅞" wide, 3⅝" high, bulb is 12" long wtih ½" IPS Connection.

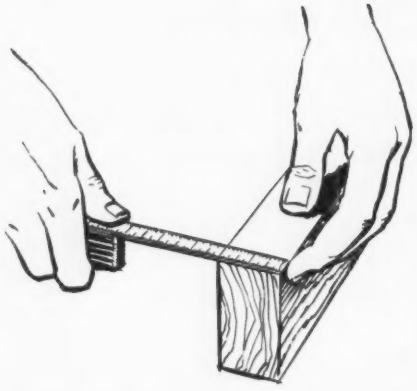
☛ ***Write for Bulletin 316*** • **Powers SERVICE is available in 85 Cities in U.S. and Canada.**







THE POWERS REGULATOR COMPANY | Skokie, Ill. • Offices in Chief Cities in U.S.A. Also Canada and Mexico • See your phone book



Measure COOLING TOWER LIFE with a RULER?

YES! DIMENSION and QUALITY of redwood are the obvious and fundamental cornerstones on which long service life and low maintenance costs must rest. They are your ONLY protection against delignification or chemical attack! Coupled with proper wood preserving treatment, they provide the necessary safeguards even in those areas where biological attack is prevalent.

COMPARE WHEN YOU BUY — AND INSIST ON GETTING THESE FOSTER WHEELER STANDARDS

THICKNESS COMPARISON OF IMPORTANT TOWER COMPONENTS

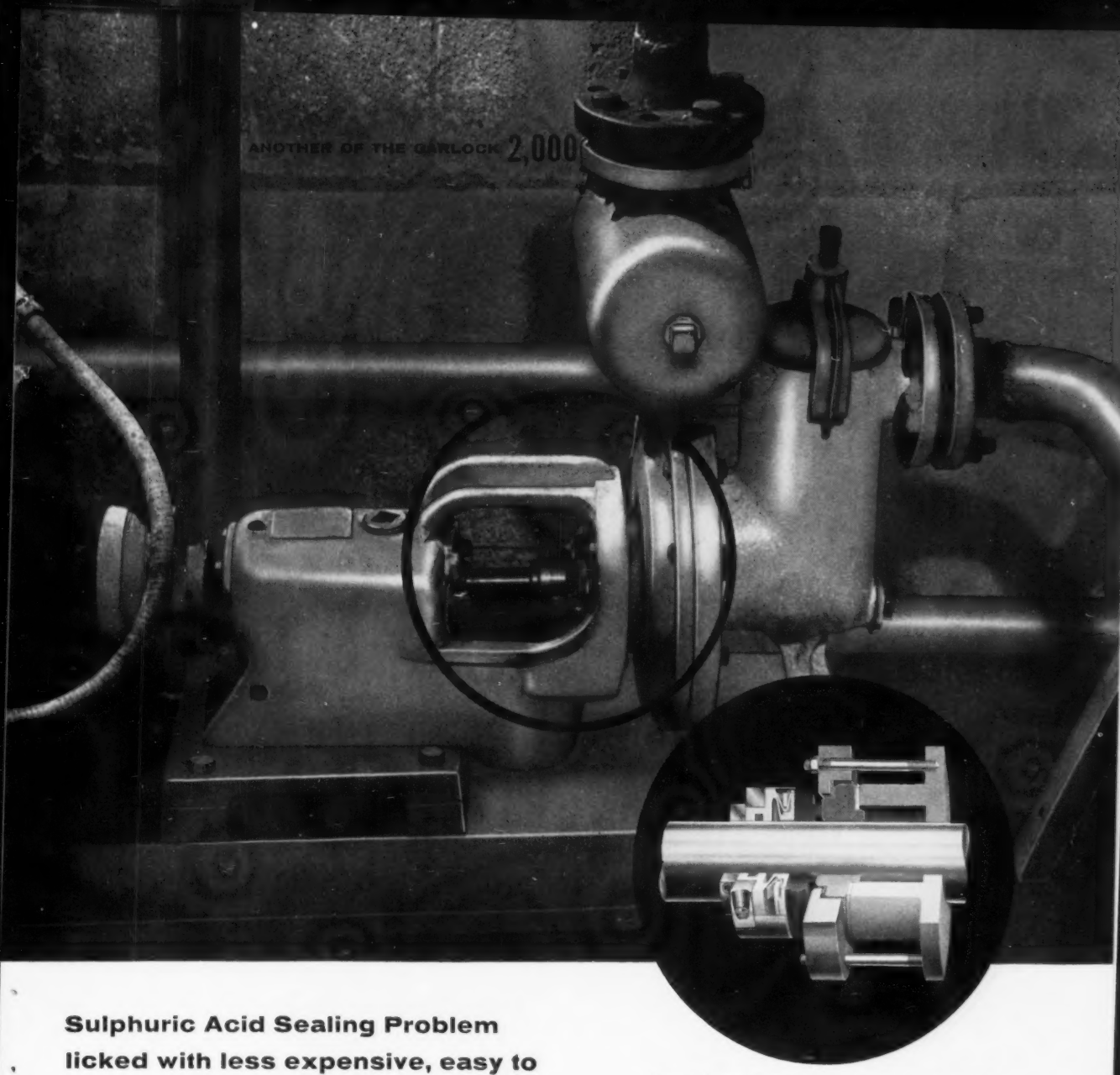
TOWER COMPONENTS	FOSTER WHEELER	MANUFACTURER "A"	MANUFACTURER "B"
SPLASH BARS	1"	1"	3/8"
FILL DECK SUPPORTS	2"	1"	1/2"
WATER DISTRIBUTION SYSTEM	2"	1"	1"
FAN STACK SHEATHING	1 1/2"	1"	3/8"
AIR INLET LOUVERS	1"	1/2"	1/2"
DRIFT ELIMINATOR BLADES	9/16"	7/16"	5/16"

"To conserve water is good business . . . for you, your neighbor, and the Nation."

FOUNDER MEMBER CTI COOLING TOWER INSTITUTE

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.



Garlock CHEMISEAL Mechanical Seal used on pumps at Continental Oil Co. has TEFLON bellows, a TEFLON-filled carbon sealing face, and ceramic stationary seat.

Sulphuric Acid Sealing Problem licked with less expensive, easy to install *Garlock Mechanical Seal*

In April 1955, Continental Oil Co., Chicago installed a standard Garlock CHEMISEAL* on a centrifugal pump handling 101.6% and 78-80% sulfuric acid for one-fourth the cost of the previous seal. This outside seal was reported easy to install by regular maintenance personnel. The service life is 8 to 10 months compared to 8 days for soft packing.

Now all centrifugal pumps in this service at Continental are equipped with Garlock CHEMISEAL Mechanical Seals. They handle up to 100,000 lbs. per day of sulfuric acid at temperatures to 135° F.

Garlock CHEMISEALS can solve your difficult sealing jobs too. Ask your Garlock representative for his recommendation. He can choose from "The Garlock 2,000" . . . two thousand different styles of packings, gaskets, and seals for every need. Or write for CHEMISEAL Folder AD-164.

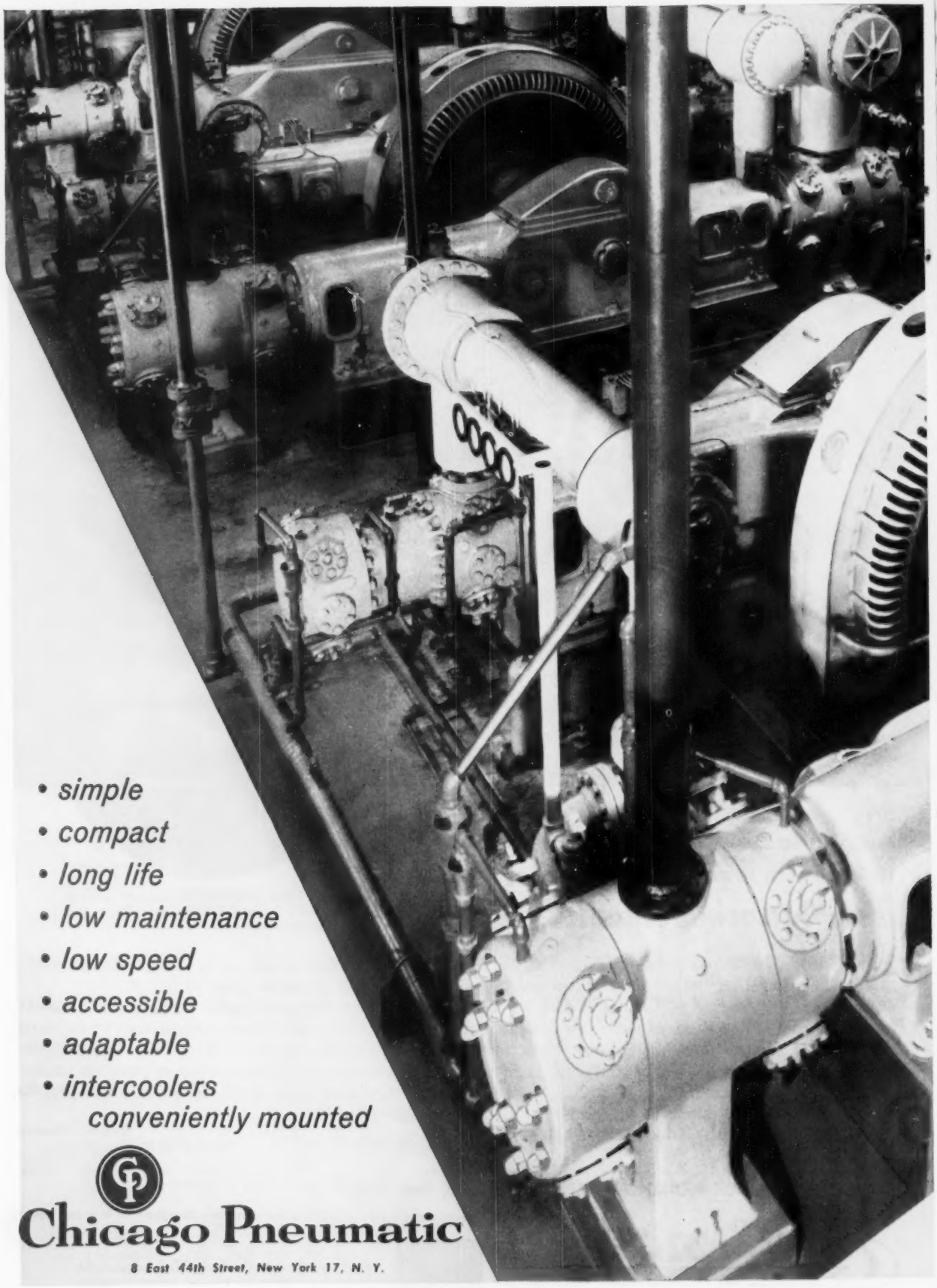
*Registered Trademark

THE GARLOCK PACKING COMPANY, Palmyra, New York

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U. S. and Canada.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products


• simple
• compact
• long life
• low maintenance
• low speed
• accessible
• adaptable
• intercoolers
conveniently mounted
Chicago Pneumatic
8 East 44th Street, New York 17, N. Y.

Class H-CE five-stage compressors, two of several on the line 24 hours a day.
Four-stage Class H compressors meet air liquefaction demands in a steel plant.

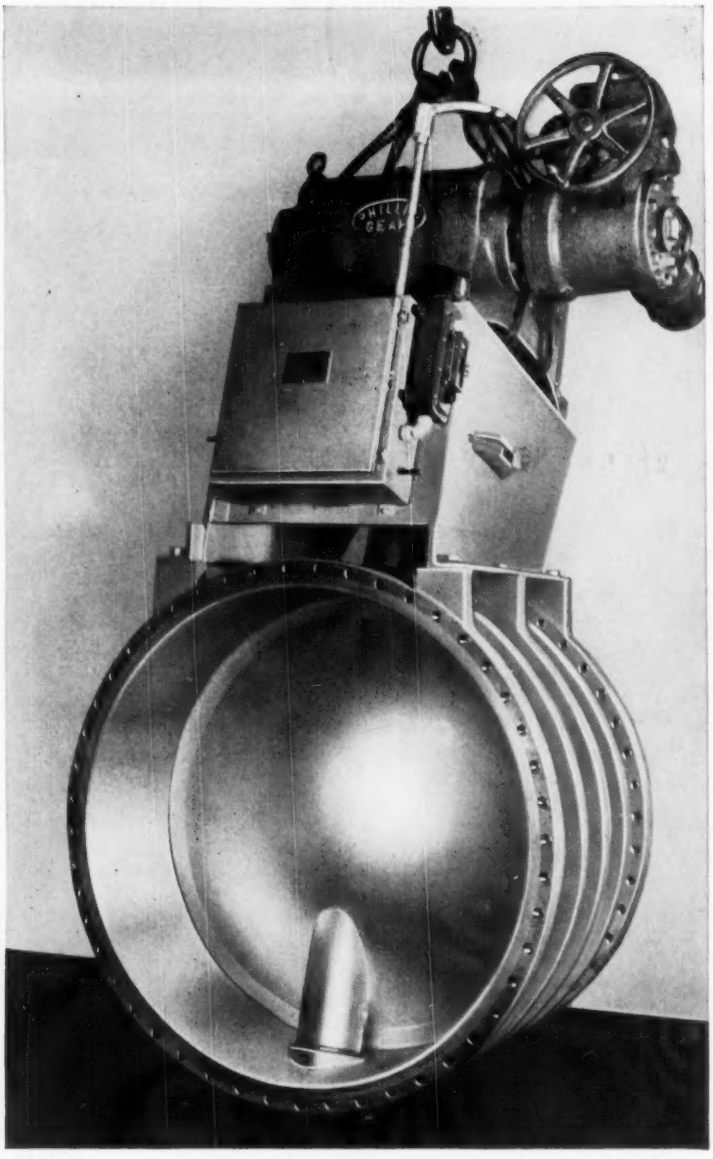
- **FOR PRESSURES TO 15,000 PSIG**
- **SIZES 200 to 2000 HP**
  (other CP Compressor models available in sizes up to 5000 hp)

CP
HORIZONTAL DUPLEX
motor-driven
COMPRESSORS

AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS

60" BUTTERFLY VALVE

...for huge Aircraft Wind Tunnel



OPERATED BY

LimiTorque VALVE CONTROL

70 psi and temperatures from 100°F to 650°F

The big Rockwell Stress-Sealed Butterfly Valve is designed to meet the close tolerance of permissable leakage in shut-off under severe operating handicaps, . . . and is built to withstand corrosive and erosive operating conditions at high temperatures and pressures. Similar valves are also used for both throttling and shut-off of process or waste gases of any kind. This large valve, and others like it are safely, accurately and dependably "push button operated" by LimiTorque Valve Controls.

With LimiTorque, one key man can, from a central control point, eliminate all guesswork and labor by opening and closing valves in remote, inaccessible or hazardous locations . . . automatically, speedily, safely and dependably.

LimiTorque is available for actuation by any power source, such as Electricity, Oil, Gas, Water or Air, . . . and is also available for micro-wave control.

LimiTorque controls can be field-mounted on existing valves of all types . . . contact your valve manufacturer or nearest LimiTorque sales-engineering office.

Send for Catalog L-550, . . . and please use your Business Letterhead when requesting a copy.

LimiTorque®

PHILADELPHIA GEAR WORKS, INC.

ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.

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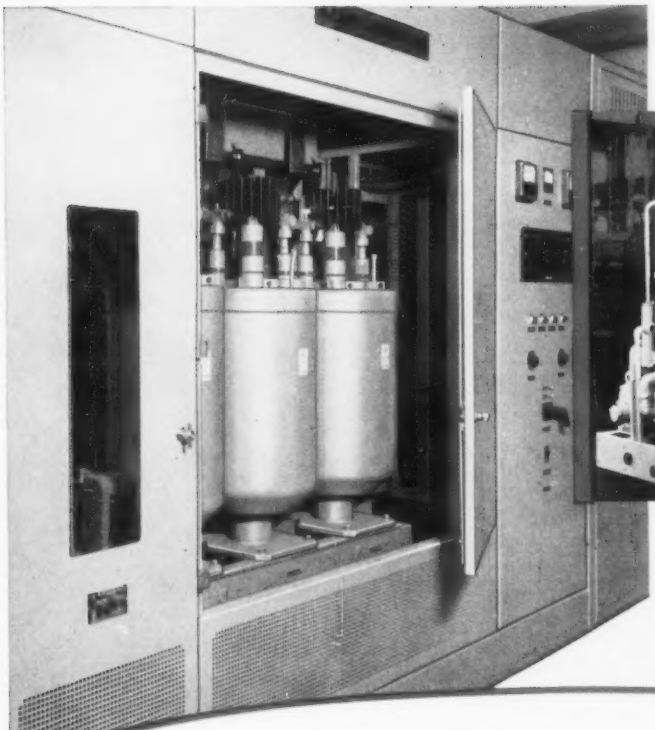
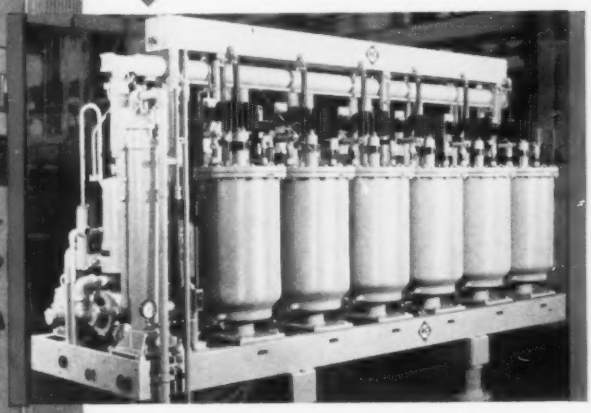
INDUSTRIAL GEARS & SPEED REDUCERS • LIMITORQUE VALVE CONTROLS • FLUID MIXERS • FLEXIBLE COUPLINGS

Limitorque Corporation • Philadelphia



Open pumped tube unit permits easy access for inspection. Easy to recondition in field.



Enclosed sealed tube unit conserves space, cuts installation costs, eliminates need for vacuum pumping system.

ALLIS-CHALMERS

Mercury Arc Rectifiers

Pumped or Sealed? Open or Enclosed?

Here's how Allis-Chalmers can help you choose a rectifier for your job—

BOTH sealed and pump-evacuated tube rectifiers offer distinct advantages, depending upon the application. Whether your rectifier should be open or enclosed construction also depends on the application. Since Allis-Chalmers offers you a choice of sealed or pumped tubes in either open or enclosed construction, you get an unbiased recommendation, based on a study of your needs, and not on commercial expediency. And you can be sure of unsurpassed reliability and ease of operation, as proved in hundreds of Allis-Chalmers installations.

Only Allis-Chalmers Excitron Rectifiers give you all these important advantages—

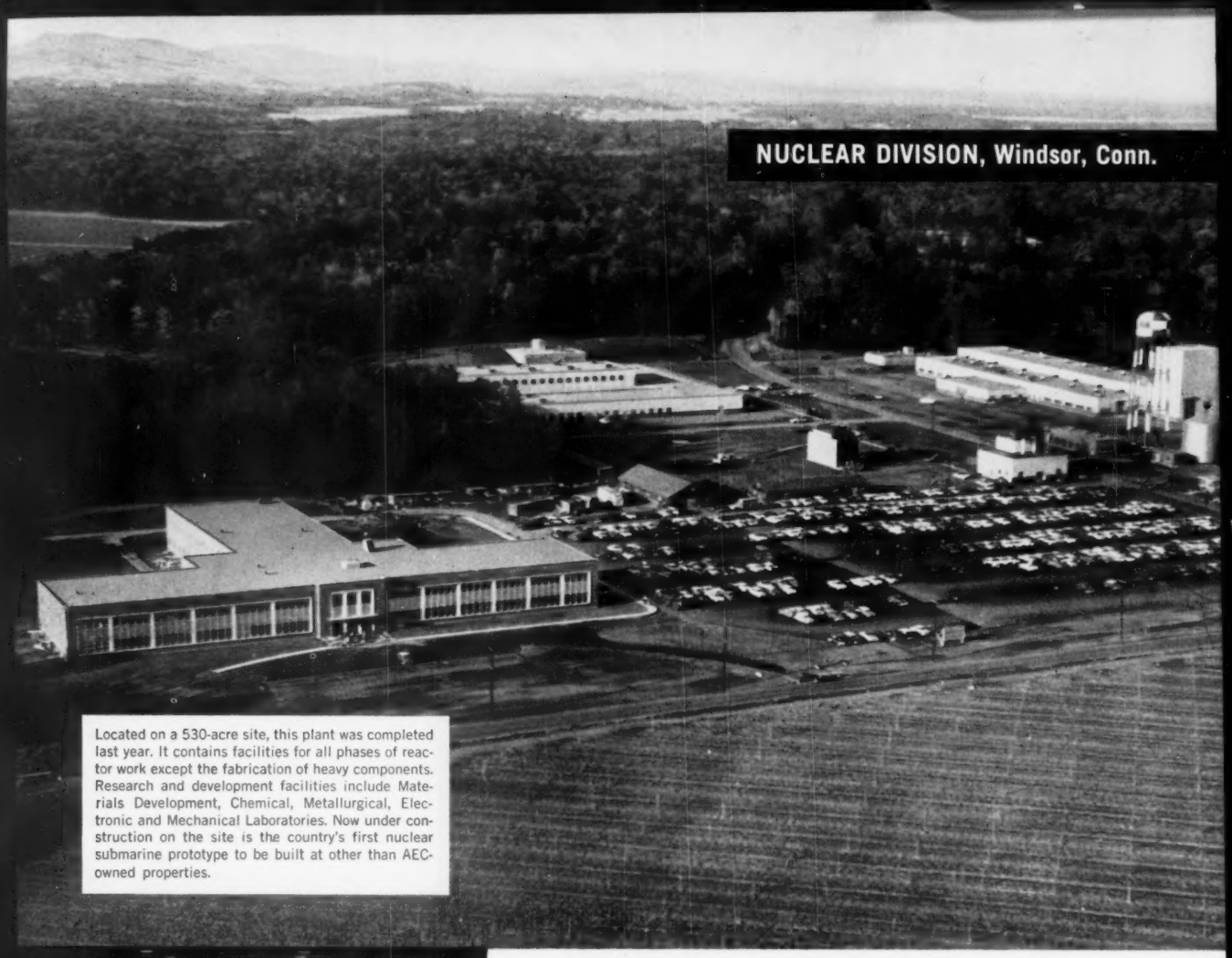
- **Fixed excitation anode** does not contact mercury — is independent of level, turbulence or impurities.
- **Continuous excitation** eliminates need for reignition — pilot arc always present.
- **Grid phase control** located in clean region near anode where ion density is lowest.
- **Internal cooling system** provides high heat transfer with seamless tube coil.
- **Arc-over-free tube** eliminates arc-over danger by insulating entire arc path.
- **Enameled anode seals** provide high strength, trouble-free seal.

For detailed information on mercury arc rectifiers contact your nearest A-C office, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin, for bulletin 12B8494.

ALLIS-CHALMERS

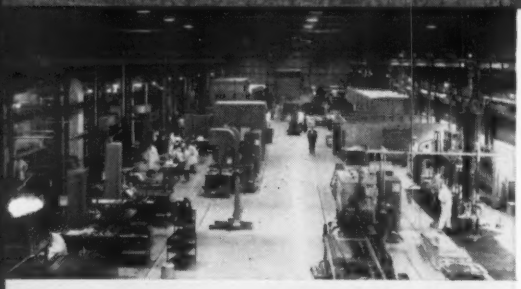
A-C ALLIS CHALMERS

A-5560



NUCLEAR DIVISION, Windsor, Conn.

Located on a 530-acre site, this plant was completed last year. It contains facilities for all phases of reactor work except the fabrication of heavy components. Research and development facilities include Materials Development, Chemical, Metallurgical, Electronic and Mechanical Laboratories. Now under construction on the site is the country's first nuclear submarine prototype to be built at other than AEC-owned properties.



(ABOVE)—Partial view of Fuel Element Manufacturing Plant at Windsor. This plant includes an 80-foot high building where the intricate job of reactor core assembly is performed.

(BELOW)—Preparing a reactor for test in one of Windsor's two Critical Assembly buildings. Facilities for reactor testing include equipment for chemical analyses, spectrography, spectrometry, destructive and non-destructive tests.

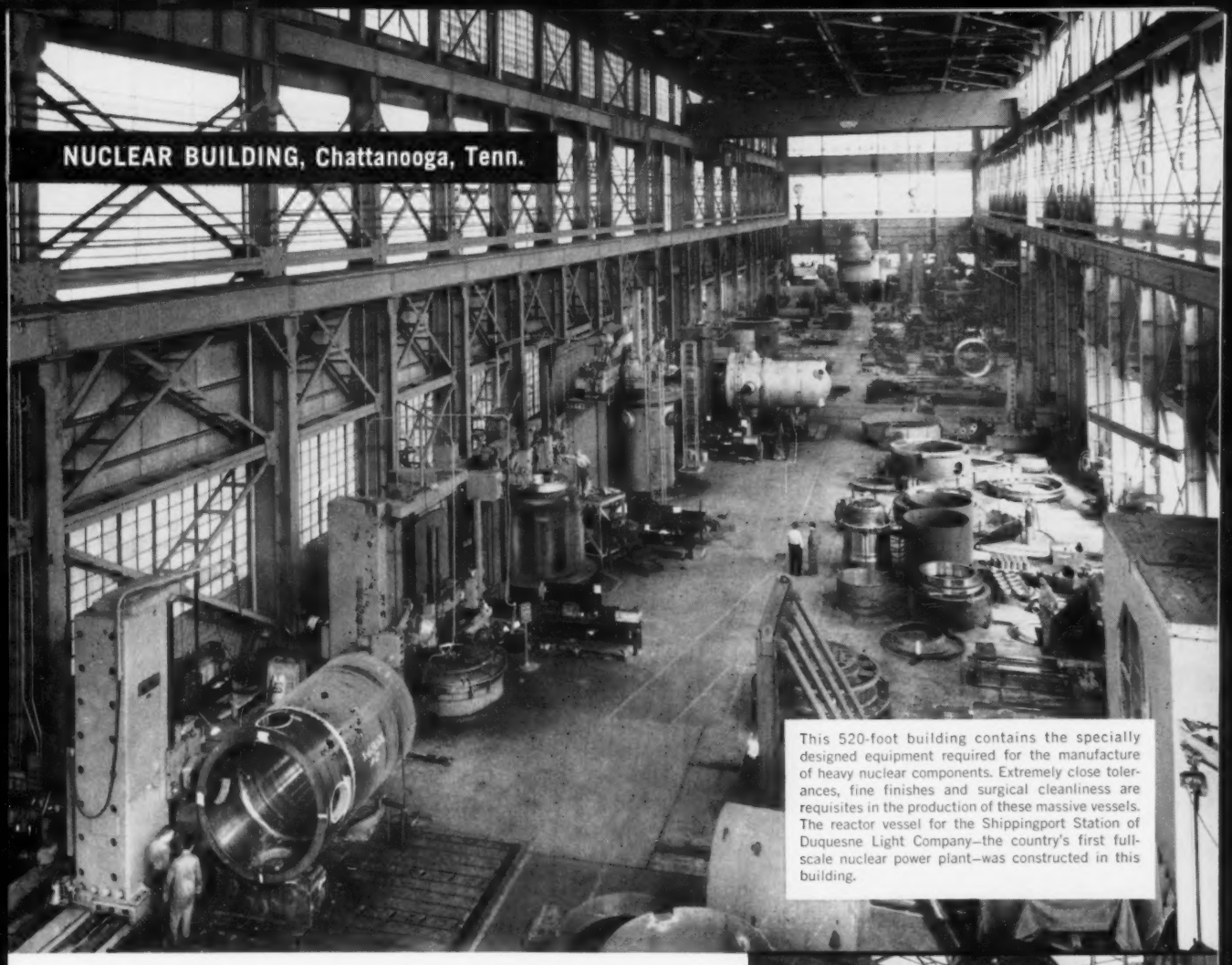
Ready FOR

On these pages are shown Combustion's facilities for the design, development, manufacture and test of complete nuclear reactor systems, including both light and heavy components. . . . These facilities, fully staffed by scientists and technicians, enable the Company to design and manufacture full-scale nuclear power installations for any requirements—civilian

COMBUSTION

Combustion Engineering Building

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;



NUCLEAR BUILDING, Chattanooga, Tenn.

This 520-foot building contains the specially designed equipment required for the manufacture of heavy nuclear components. Extremely close tolerances, fine finishes and surgical cleanliness are requisites in the production of these massive vessels. The reactor vessel for the Shippingport Station of Duquesne Light Company—the country's first full-scale nuclear power plant—was constructed in this building.

THE ATOMIC AGE

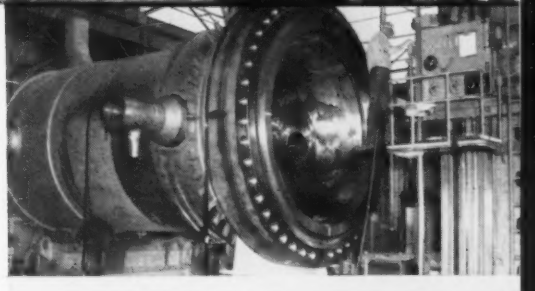
or military. . . . Combustion is also equipped and qualified to serve the nuclear field in the development of Materials, Mechanisms and Processes, and to provide such special services as Safety Consulting, Radiation Surveys, and Chemical and Biological Analyses. Information on these special services is available and will be sent on request.

C-153

ENGINEERING

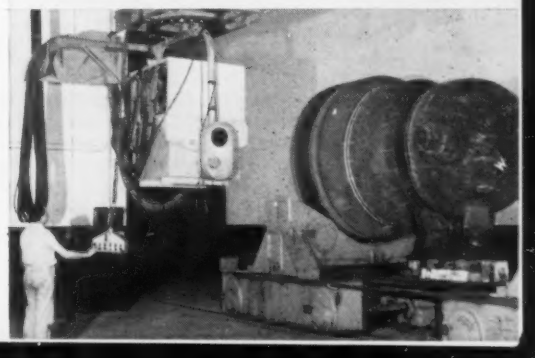
200 Madison Avenue, New York 16, N. Y.

BOILER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE



(ABOVE)—Reactor vessel being machined on large horizontal boring mill at Chattanooga. Other specially designed equipment for heavy component fabrication includes cladders, submerged arc and pressure welders, and optical alignment devices.

(BELOW)—15-million volt Betatron X-raying reactor vessel welds. Other Chattanooga testing facilities include equipment for ultrasonic and metallographic examination.



HAGAN RING BALANCE FEATURES—NO. 5

wide range AUTOMATIC COMPENSATION for PRESSURE-TEMPERATURE variations

In any metering application where true level or flow cannot be inferred from differential alone, because of variations in fluid density, the Hagan Ring Balance meter can be compensated for these variations.

A simple, integral linkage computes the correction factor from temperature, pressure, density or a combination of these and applies the correction automatically. The accuracy of this correction is maintained over a wide operating range by the geometry of the linkage.

The Ring Balance compensated meter gives all the information necessary for a quick, visual check of the computation it is performing. Both the corrected and uncorrected values as well as all variables are displayed either as records or indications.

With fifteen years of pioneering in the practical application of precise metering, such difficult measurements as drum level in high pressure boilers, pre-heated air flow, delivery of blowers and exhausters, and extraction steam flow, Hagan engineers have the experience and background to help you solve either routine or unusual metering problems.

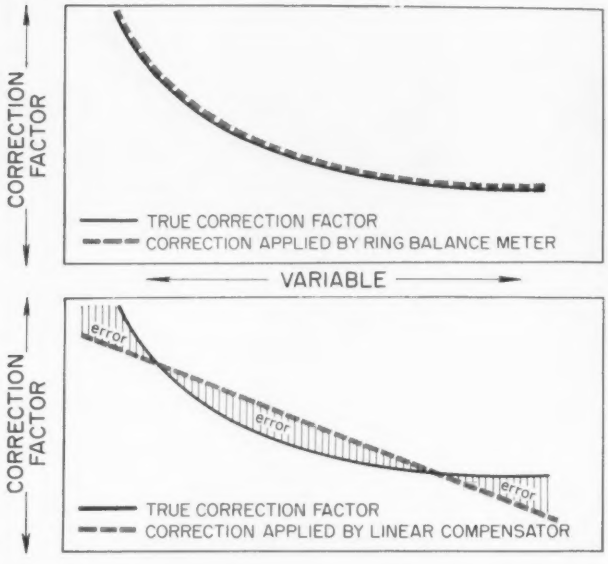
Ask your Hagan engineer to explain these other Ring Balance features:

1. Ease of calibration under operating static pressures with factory calibrated check weights! No more four-story water columns and telephones!
2. Safe operation with rings rated at 2,500, 6,000, 15,000 psig. No gaskets, no stuffing boxes.
3. Sealing fluid density and level not critical. No eye-droppers required.
4. Interchangeable ring assemblies for full scale ranges from 0.5" w.c. to 560" w.c. Adjustment on any one ring over a 7:1 differential range.
5. High sensitivity at low flows due to unique range calibration system.
6. Pneumatic or electric transmission also available. Any Ring Balance meter can be equipped with slide-wire for operation with data-logging devices and for transmission to the Hagan PowrLog.

For additional information, write for Bulletin MSP 147.

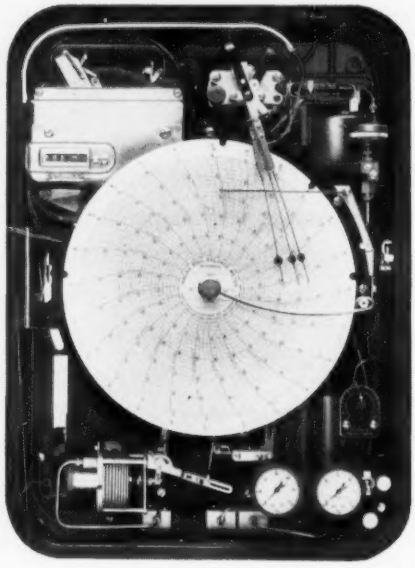
HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO

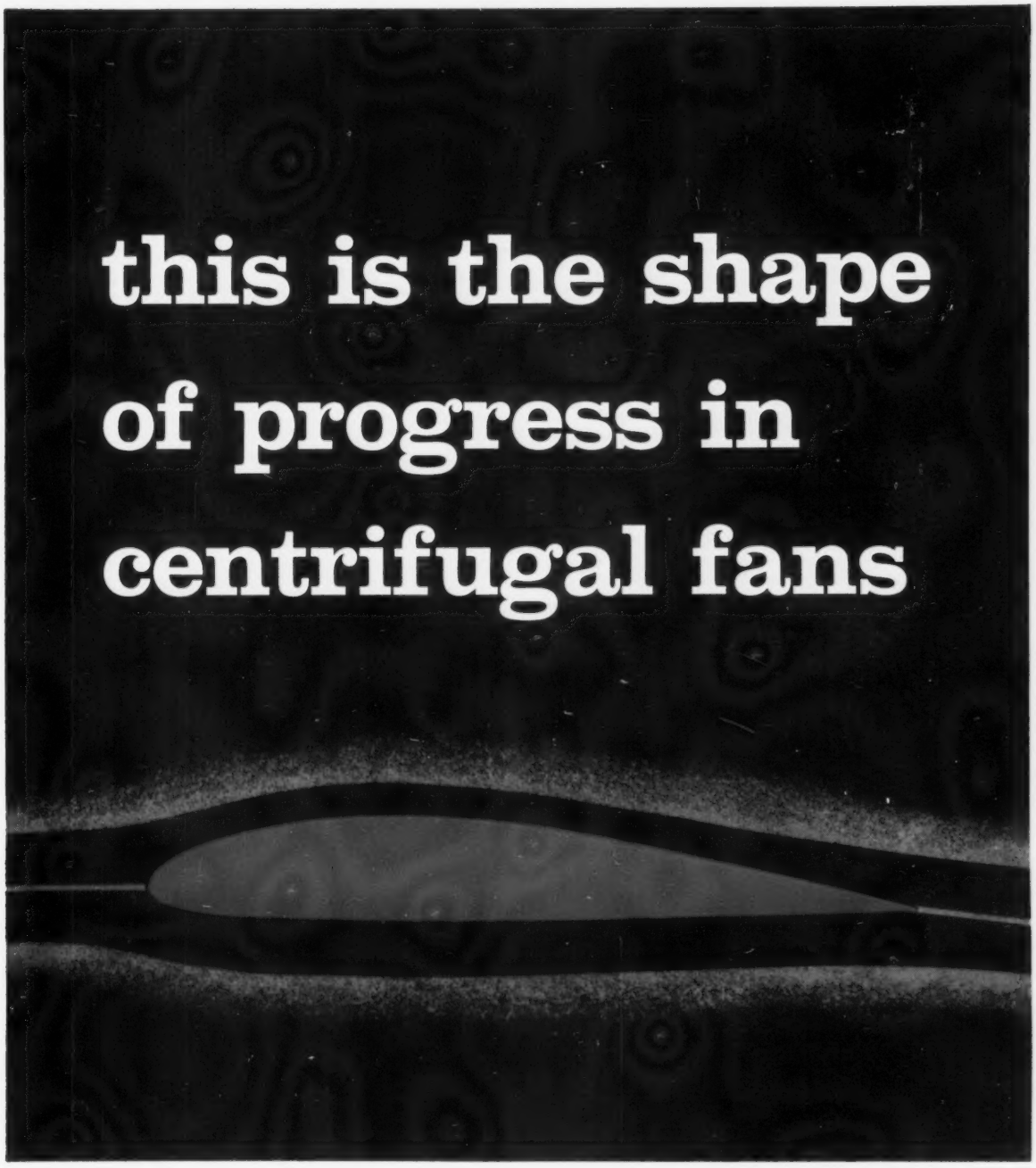


Wide range compensation is made possible in the Hagan Ring Balance meter by the unique curvilinear motion generator. The compensation applied is correct throughout its entire range because it is characterized to fit the true correction curve at all points—see top diagram.

Other methods of compensation, which utilize straight-line correction, conform to the true correction curve at only two points, producing error in the compensation as shown in the bottom diagram.



Compensated Hagan Ring Balance meter with door removed. The three pens record uncorrected flow, corrected flow and pressure. Corrected flow can be integrated and transmitted for remote recording or control purposes.



Westinghouse Airfoil Blading, the last word in centrifugal fan design, provides efficiency and quietness in mechanical draft applications.

With these advantages:

- Quiet Operation
- Lowest Operating Costs
- Stable Pressure
- Non-Overloading Feature

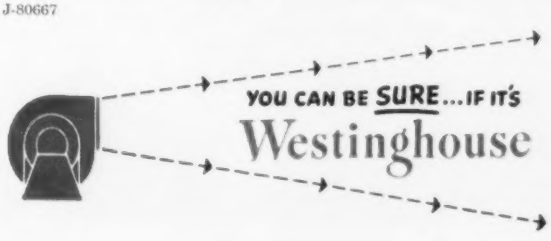
Available with Airfoil Blading:

Primary Air Fans
up to 40,000 cfm . . . . . up to 65″ pressure
Combustion Air Fans (High-Pressure Forced-Draft)
up to 350,000 cfm . . . . . up to 90″ pressure
Combustion Air Fans (Standard Mechanical Draft)
up to 700,000 cfm . . . . . up to 40″ pressure

More Information?

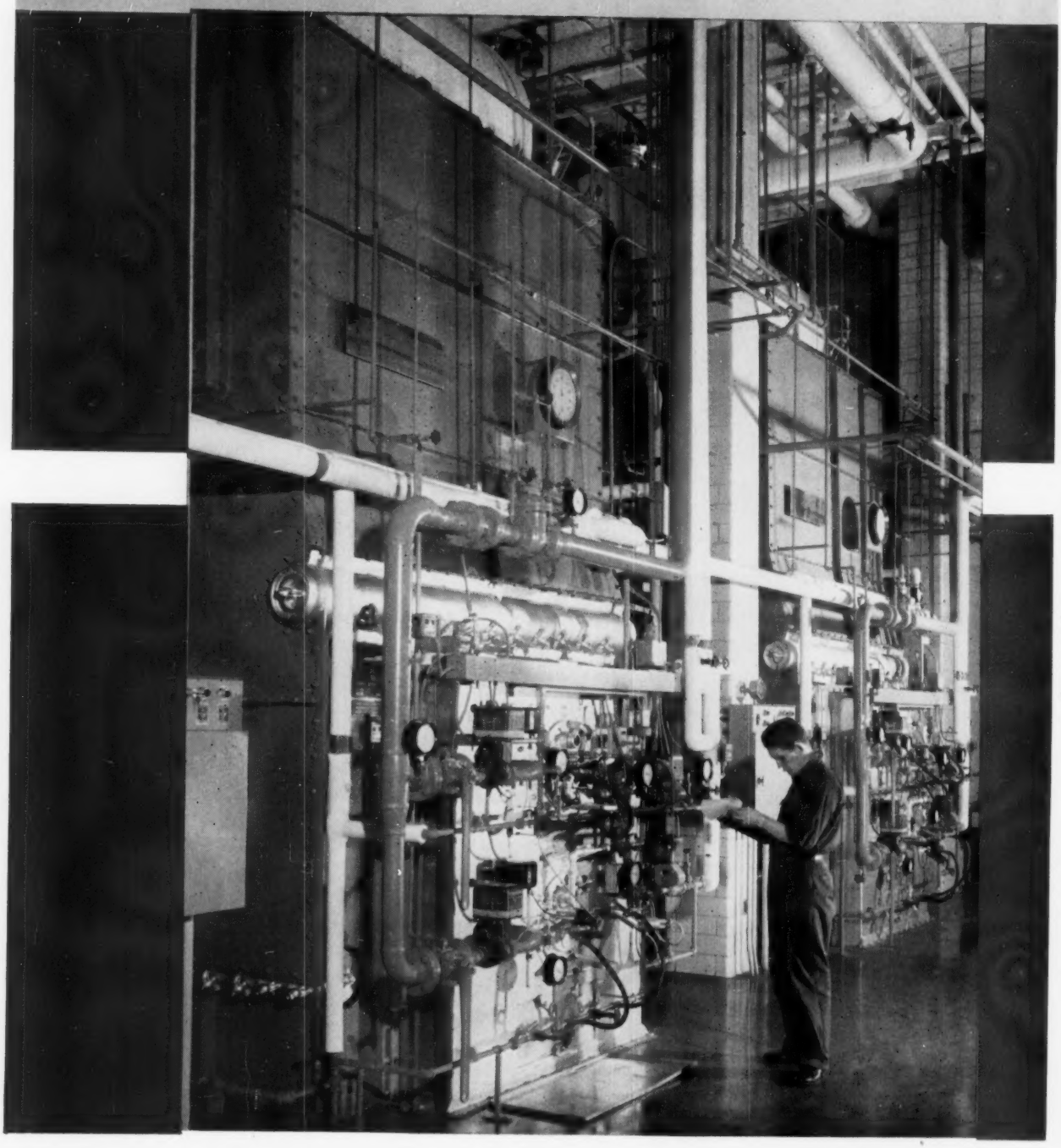
Call your nearest Sturtevant Division Sales Engineer or write Westinghouse Electric Corporation, Dept. E-15, Hyde Park, Boston 36, Massachusetts.

J-80667



WICKES TYPE S-1AL

HEAT ONE OF AMERICA'S



STEAM GENERATORS
MOST MODERN BUILDINGS

CONNECTICUT GENERAL LIFE INSURANCE CO., Bloomfield, Conn.

ARCHITECTS:
Skidmore, Owings & Merrill

GENERAL CONTRACTOR:
Turner Construction Co.

MECHANICAL CONTRACTOR:
Kerby Saunders, Inc.

A recent exhibit at the National Gallery features 10 of America's most modern buildings. The American Institute of Architects, on the occasion of its Centennial, included in the exhibit the new home office of the Connecticut General Life Insurance Company in suburban Hartford, which is equipped with Wickes boilers. This spacious, sun-flooded building of steel and glass, is nearly a modern city in itself, for it houses not only the complete office system, but includes employee lounges, game rooms, medical department, mailrooms, auditorium, bowling alleys, barber and beauty shops as well.

For the heating system in this mammoth structure, engineers chose to install two Wickes type S-1AL steam generators equipped with both oil and gas burners. In addition to general heating, the steam generators provide power to operate the refrigeration machines and a snow-melting system on the truck ramp. The boilers each have 3700 sq. ft. of heating surface, and were designed for a maximum continuous load of 27,500 pounds of steam per hour at 200 PSIG.

Bulletin No. 55-1 gives complete facts on Wickes products. New engineering bulletins on Type-S and Type-A Steam Generators are also available on request.

WICKES

WICKES BOILER CO.

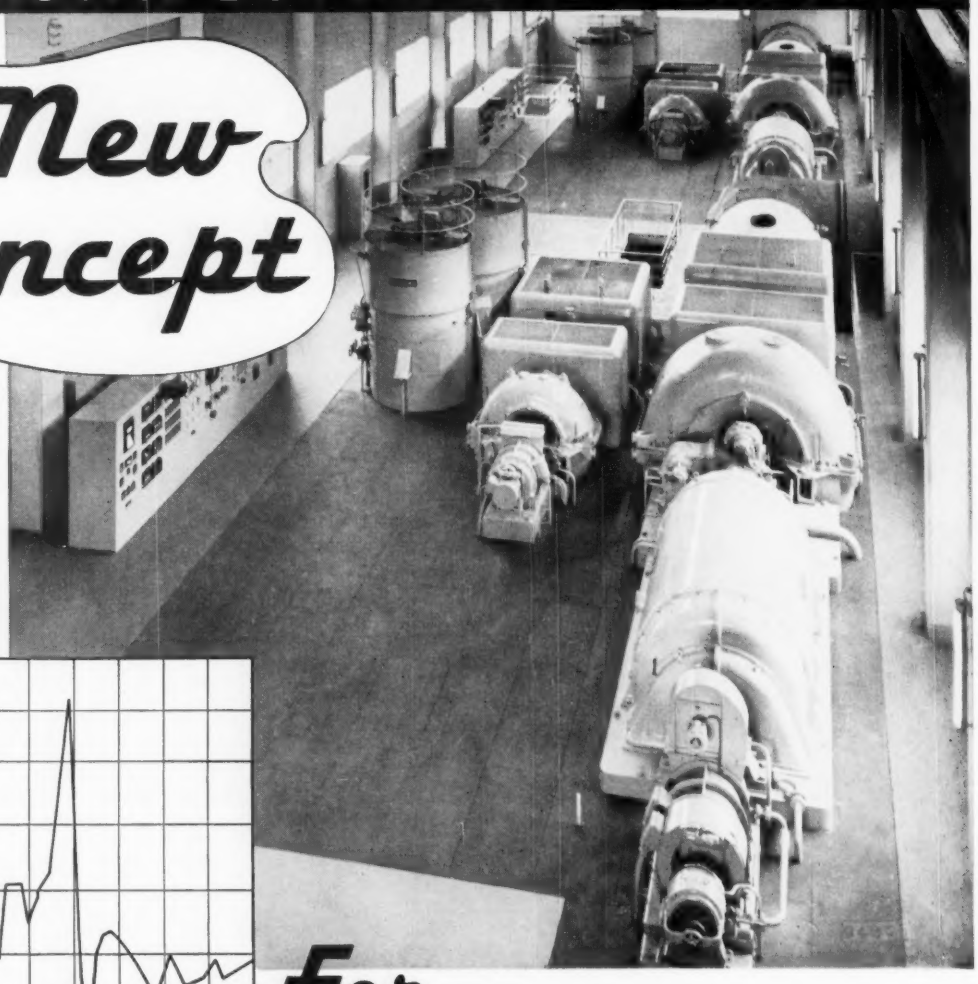
DIVISION OF THE WICKES CORPORATION, SAGINAW, MICHIGAN

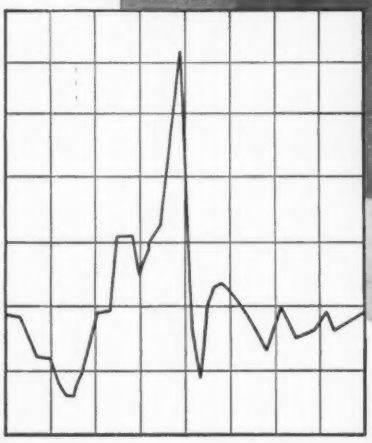
RECOGNIZED QUALITY SINCE 1854 • ***SALES OFFICES:*** Boston • Chicago • Cleveland • Dallas • Denver • Detroit • Houston Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • New Orleans • Portland, Ore. • Saginaw San Francisco • Springfield, Ill. • Tulsa

168

BROWN BOVERI GAS TURBINES

A New Concept





For Peak Loads

DEPENDING on the load, either the 7,000 kW single shaft or the 25,000 kW non-regenerative cycle Brown Boveri Gas Turbine provide the answer to the rigid demands of peak load service. *They can be put on the line in 20 minutes or less.*

Their on-the-job performance records—in over 60 power plants throughout the world—conclusively indicate not only economy of operation but sizeable savings in initial costs.

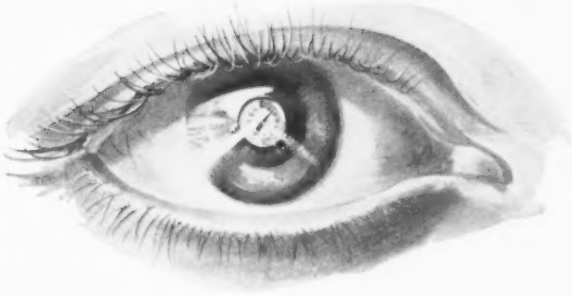
If your problem is *peak* or *base* load service, it will pay you to investigate Brown Boveri Gas Turbines.

BROWN BOVERI

BROWN BOVERI CORPORATION

19 RECTOR STREET • NEW YORK 6, N. Y.

Atlanta, Ga. • Birmingham, Ala. • Boston, Mass. • Buffalo, N. Y. • Chicago, Ill. • Cleveland, O. • Dallas, Tex. • Denver, Colo. • Detroit, Mich. Hamilton, O. • Jacksonville, Fla. • Kansas City, Mo. • Knoxville, Tenn. • Miami, Fla. • Minneapolis, Minn. • New Orleans, La. • New York, N. Y. Pasadena, Cal. • Pittsburgh, Pa. • Portland, Ore. • Roanoke, Va. • San Francisco, Cal. • San Juan, P. R. • Syracuse, N. Y. • Tucson, Ariz.



What you read is right

The new, patented Maxivision dial on American Bi-Metal Thermometers eliminates the perspective effect of usual pointer-above-dial construction. No parallax! Readings are sure, sharp and accurate – exact working temperatures are always right before your eyes. It is a two-level dial. A raised outer ring, set close to the cover glass, carries the graduations. The index type pointer is on the same plane as the outer ring, with the numerals on a lower level.

What you read is right when American Bi-Metal Thermometers with anti-parallax Maxivision dial are installed at important check points on your processing facilities. Mounting styles, dial sizes, temperature ranges and stem lengths are available to meet the most exacting requirements. Let your nearby industrial distributor help you select the best combination for each location.

American Bi-Metal Thermometer with Maxivision Dial. Suitable for indoor or outdoor service.

MANNING MAXWELL & MOORE INC. M&M TRADE MARK

AMERICAN INDUSTRIAL THERMOMETERS

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
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We've reserved a copy for you

PEERLESS PUMP DIVISION, FOOD MACHINERY AND CHEMICAL CORPORATION
301 West Avenue 26, Los Angeles 31, California

Please send ☐ Bulletin No. EM-79, MECHANICAL CONSIDERATIONS IN PUMP DESIGN
____copies of: ☐ Bulletin No. B-1608, TYPE DL-DM CHEMICAL PROCESS PUMPS

NAME_____

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POW

Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION
Peerless Pump Division
Plants: LOS ANGELES 31, CALIFORNIA and INDIANAPOLIS 8, INDIANA

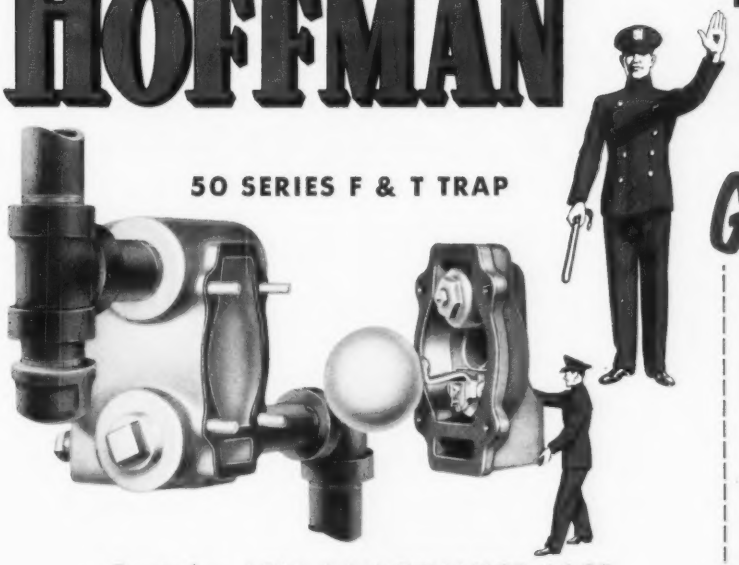
RESUME OF ORIGINAL RESEARCH ON

PUMP RADIAL LOADS AND STRESSES

Describing the cause, effect, and cure of radial thrust forces on pump impellers, bearings, wear rings, seals, stuffing boxes and the shaft itself, the booklet "MECHANICAL CONSIDERATIONS IN PUMP DESIGN" covers the basic types of process pumps, and discusses the load effects on each. Eight pages, profusely illustrated, this informative reference booklet is now available to engineers and pump buyers. For your copy, send coupon today.

PEERLESS PUMPS

HOFFMAN TRAPS



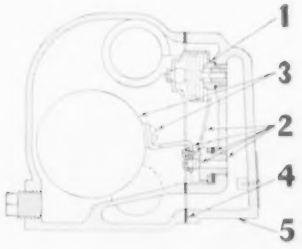
50 SERIES F & T TRAP

GUARD AGAINST STEAM WASTE

Hoffman Traps provide improved design to *function more effectively and economically in removing condensate* from steam lines and equipment.

Hoffman engineers have anticipated steam requirements that demand less maintenance time and operating costs. Typical of Hoffman's complete line are the Traps illustrated, each with removable cover, pin and seat for quick inspection and cleaning.

***Featuring* LOW MAINTENANCE COST**



Float and Thermostatic Traps are so designed that all working parts of the trap are a part of the removable cover. Once installed there is no necessity for the breaking of any pipe connection for cleaning and repairing.

1. Compact Thermostat Assembly
2. Durable, accurately machined Valve Lever and Seat Assembly
3. Copper Float Ball Assembly
4. Graphite Impregnated Asbestos Gasket
5. Heavy Duty Cast Iron Cover

LOW, MEDIUM & HIGH PRESSURE THERMOSTATIC TRAPS

RENEWABLE THERMOSTATS and VALVE SEATS

A complete line of Low, Medium and High Pressure Thermostatic Traps for service with radiation, dryers, sterilizers, mangles, cookers and similar uses. Renewable thermostats and seats are important constructional features contributing to long life, low cost service. Medium and High Pressure Traps have stainless steel pins and renewable seats.

600 SERIES INVERTED BUCKET TRAP

1. Cover assembly with plug, valve seat, valve seat holder.
2. Bucket assembly with lever, valve stem, bucket pin, lock nut and bucket.
3. Body assembly with gasket and bottom drain plug.

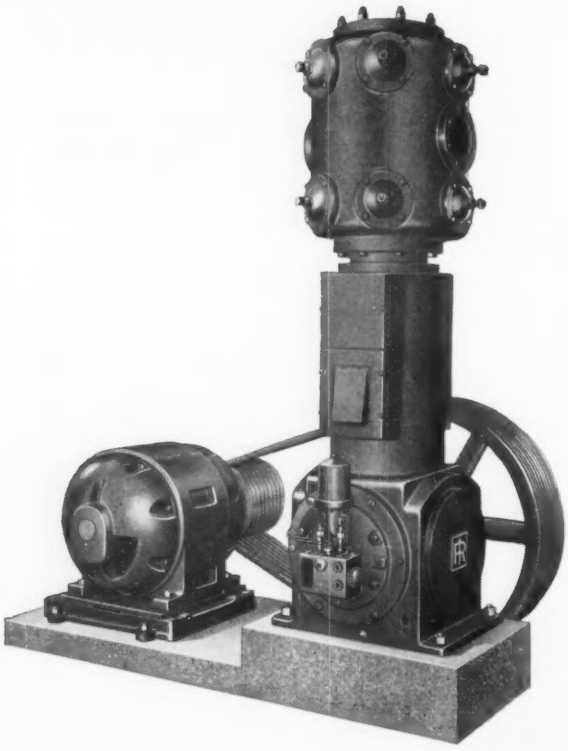
HIGHLY EFFICIENT AND EASILY ACCESSIBLE INTERIOR DESIGN

Hoffman Bucket Traps operate intermittently and are ideal for draining condensate and air from steam lines or equipment where large quantities of air and condensate must be discharged. They are easily inspected, cleaned and serviced by merely removing the cover assembly.

For full particulars, write for catalogs on Bucket Traps, Float and Thermostatic Traps or Thermostatic Traps

HOFFMAN SPECIALTY MANUFACTURING CORP.

NEW Ingersoll-Rand ESH IN DESIGN

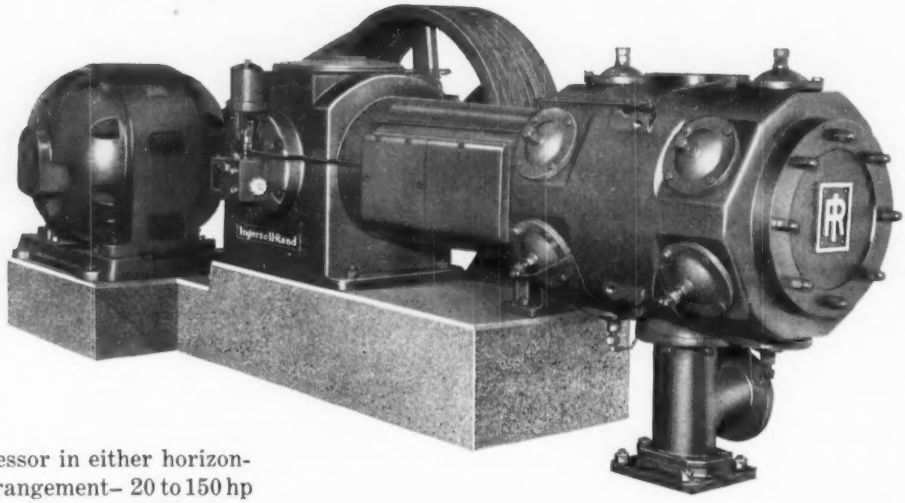


ESV

(vertical) *

ESH

(horizontal) *



*The same compressor in either horizontal or vertical arrangement– 20 to 150 hp sizes, single- and multi-stage, pressures up to 5000 psi and vacuums.

and ESV compressors...

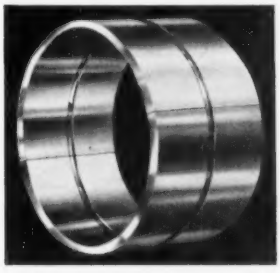
AND PERFORMANCE

...with heavy-duty features proven in larger Ingersoll-Rand Compressors

Here's an entirely new line of compressors, built to run longer—much longer. They're more compact, more efficient, and require less attendance, less maintenance. They offer greater capacity in less space, and are ruggedly built and highly refined to take years of continuous hard service. The ESH and ESV are part of the modern generation of the Ingersoll-Rand compressor family—a family 80 years young.

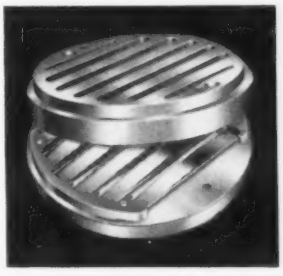
Never a need for adjustments—frame is kept sealed! All running parts are precision-machined and need no fitting or adjusting, so the frame is sealed—dirt stays out, and the major causes of wear are eliminated!

• Full-floating aluminum bearings never need adjustment



The full-floating bearings "roll with the punch" taking each major thrust on a different portion of the shell. They are foolproof, and never require fitting or adjustment. Main and crankpin bearings are made of I-R's special aluminum bearing alloy, which has higher load capacity and better heat conductivity than other bearing materials.

• Air-cushioned Channel Valves give unmatched performance



Known the world over for lasting efficiency, dependability and quiet operation, Ingersoll-Rand air-cushioned Type A Channel Valves are entirely different in design and principle from any other valves in use. Type A Channel Valves were developed especially for modern compressor speeds, and feature a separate stainless steel seat plate which can be reversed or replaced for new life.

There are many other design features—including filtered force-feed lubrication and full-floating, self-adjusting metallic packing—that have heretofore been found only in larger Ingersoll-Rand compressors. Let your I-R representative tell you more about these new compressors for air or gas, and how they can save you money.

Ingersoll-Rand

I-814

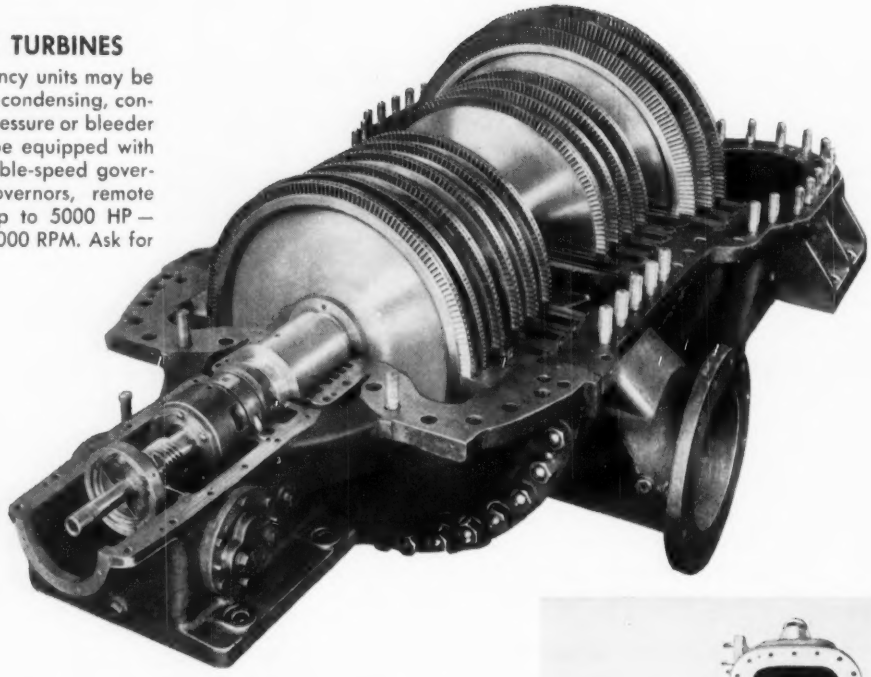
11 Broadway, New York 4, N. Y.

IN ENGINEERED PRODUCTS, THERE'S NO SUBSTITUTE FOR EXPERIENCE!

COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

MULTI-STAGE TURBINES

These high-efficiency units may be designed for non-condensing, condensing, mixed pressure or bleeder operation. Can be equipped with constant or variable-speed governors, special governors, remote controls. Sizes up to 5000 HP — Speeds up to 10,000 RPM. Ask for Bulletin S-146.



There's a **Terry turbine** for every mechanical-drive requirement

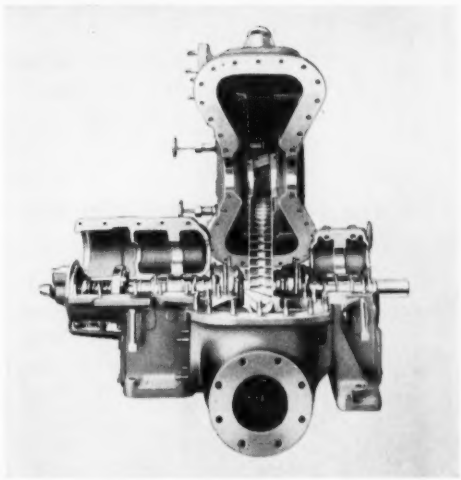
The designs for Terry turbines are based on more than 50 years of successful experience in the manufacture of turbine drives *exclusively*. This specialization has resulted in Terry becoming one of *the leading producers* of mechanical-drive turbines in sizes up to 5,000 horsepower.

There are three basic reasons why Terry has been able to maintain this position of leadership: (1) a thorough knowledge of the requirements of mechanical-drive turbines, (2) a willingness to build "a little something extra" into each machine to assure trouble-free operation, and (3) an acknowledgement of the company's responsibility to stand behind the performance of every turbine sold.

These are also the reasons why you should consider a Terry turbine for your next mechanical drive. In the meantime, send for bulletins describing any of the types of machines illustrated.

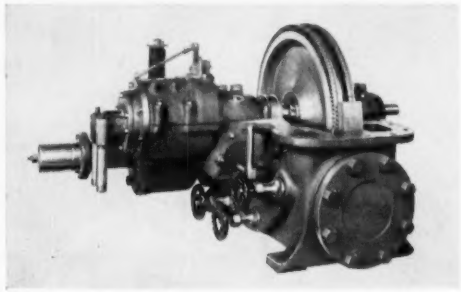
THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TERRY



SOLID-WHEEL TURBINES

Famous for sure dependability and ease of inspection. Can be started cold — no preliminary warming required. Available in vertical designs depending on frame size. Capacities from 5 to 2,000 HP. Described in Bulletin S-116.



AXIAL-FLOW IMPULSE TURBINES

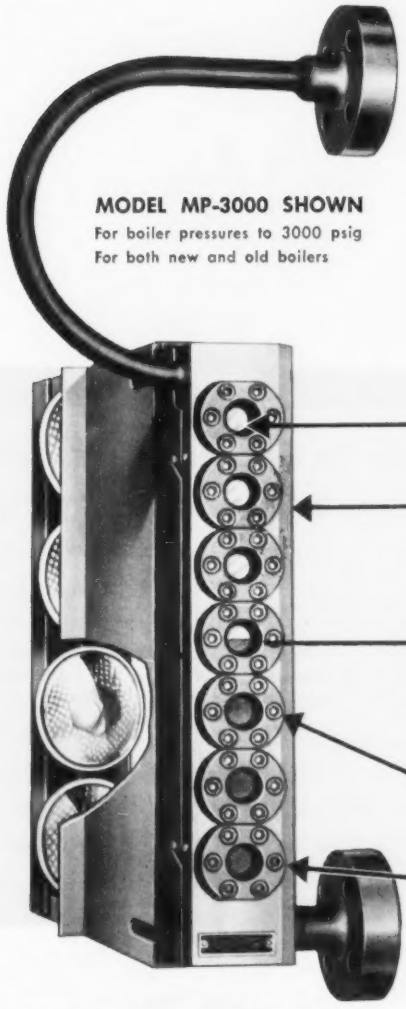
Built with one, two or three rows of high-grade stainless steel blading, these turbines combine efficiency with durability. Available in designs for moderate and high steam pressure. Bulletin S-143.

TT-1209

MORE THAN ~~950~~ ~~1400~~ 2000

DIAMOND MULTI-PORT GAUGES

In use and on order for over ~~240~~ ~~300~~ 315 Central Station Generating Plants



MODEL MP-3000 SHOWN
For boiler pressures to 3000 psig
For both new and old boilers

SMALL ROUND PORTS INSTEAD OF LONG GLASS AND MICA STRIPS

GAUGE NEVER REMOVED FROM BOILER FOR GASKET CHANGES OR OTHER NORMAL MAINTENANCE

STEAM SHOWS RED

WATER SHOWS GREEN

Also available is Model MP-900 for boiler pressures to 900 psig

COMPLETE PORT CHANGE REQUIRES ONLY ABOUT 15 MINUTES

EACH PORT THERMALLY INDEPENDENT

Because the Diamond Multi-Port solves the problems inherent in water level gauges on boilers operating at high temperatures and pressures, it has had rapid and wide acceptance. In addition to the 2000 for central station generating plants, more than 185 have been sold to industrial power plants.

Advantages of the Multi-Port are many. In addition to those shown above, it has maximum thermal stability for rapid starting . . . "Hi-Lite" illuminator for improved readability . . . welded construction for permanent tightness . . . end stems can be furnished instead of flanges . . . startling reductions in maintenance costs.

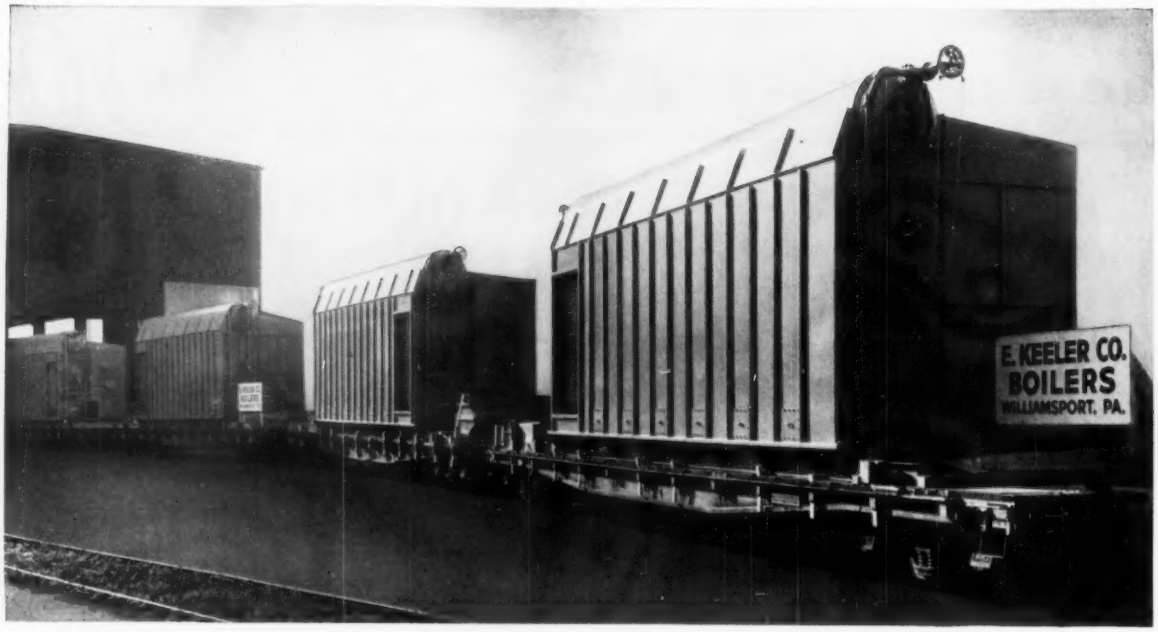
Write for Bulletin 1174 (Model MP-3000) or Bulletin 2044 (Model MP-900) for more information.

8032

Diamond

DIAMOND POWER SPECIALTY CORP.

LANCASTER, OHIO • DIAMOND SPECIALTY LIMITED — *Windsor, Ontario*



Four 50,000-lb. capacity Keeler D-K Package Units to supply major auto producer's steam requirements

The four large package steam generators above are shown just outside the recently completed KEELER package unit assembly plant, ready for shipment to a major automobile manufacturer.

Oil-fired, each of these KEELER D-K steam generators have a capacity of 50,000-lbs. of steam per hour at a maximum design pressure of 200 psi. They were selected for their ability to efficiently supply a more flexible steam load in the purchaser's heat and process requirements. The complete package includes all burning equipment, controls, safety devices and accessories—ready for quick hook-up and operation.

KEELER water tube steam generators of various types and sizes are serving this user in several plants throughout the country. Satisfaction with previous installations and the KEELER reputation as a builder of better boilers since 1864 led to this repeat order.

Type D-K KEELER package steam generators are compact package power plants, made in oil or gas fired units with capacities up to 60,000-lbs. of steam per hour. Standard design pressures range from 200 to 500 psi. They incorporate the popular D-type tube arrangement in a completely steel encased package, with water cooled and insulated furnace sides, roof and floor as well as front and rear walls.

Write for illustrated bulletin containing full specifications on these compact Package Power Plants.

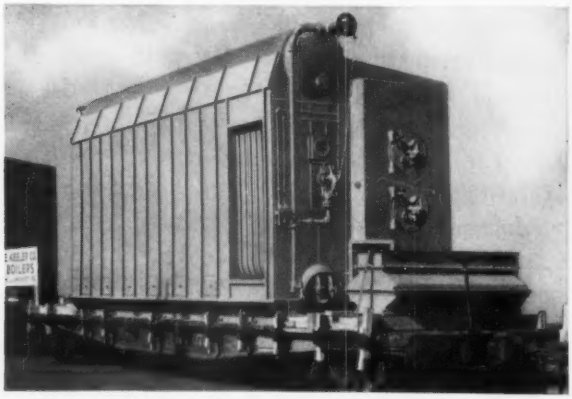
E. KEELER COMPANY

200-300 West St. • Williamsport, Penna.

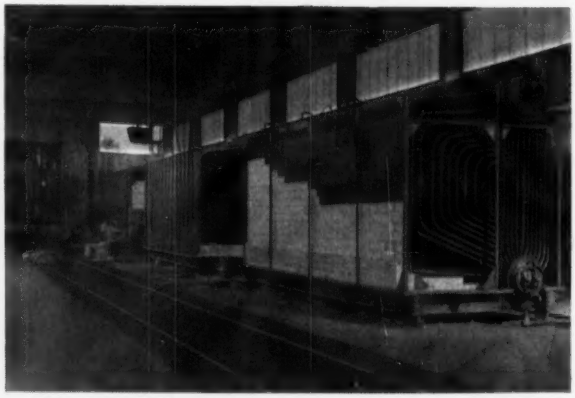
ESTABLISHED 1864

The Seal of Quality in Water Tube Steam Generators

KEELER WATER TUBE Boilers



"Front end" closeup view shows side gas outlet; burners mounted on wind box; and soot blowers piped to the main control valve on the D-K's steam drum.



Interior view of new Keeler assembly shop shows D-K units in various stages of completion. D-type tube arrangement can be seen in the foreground unit.

LOUIS N ROWLEY, EDITOR • MAY 1958 • ESTABLISHED 1882 **Power**

Why do people work?

AT FIRST glance, delving into the reasons why people work has all the earmarks of an interesting, but not particularly important, mental exercise. Actually, few questions are of greater direct, practical concern to us as engineers and managers.

We spend a major fraction of our time working with our associates or directing their work. In both cases, our chances of getting the job done smoothly and efficiently are increased enormously if we understand why people work.

Some of the reasons seem obvious. You could wrap up a big bunch of them by saying people work to satisfy basic needs—to provide themselves and their families with the necessities, and some of the luxuries, of life. And since money buys these things you could boil the answer down even further and say that people work for money.

This might be called the "paycheck theory," and for all too many managers it's the whole story. They'll admit that most of us have psychological as well as physical needs—the need to belong, the need to be recognized and respected, often the need to dominate, and many others. But, they argue, these needs too can be satisfied by money, by the standing in the community that money and possessions are said to bring.

Even if this were true—and our own experience tells us it is only partly true—the "paycheck theory" overlooks one factor that can be of tremendous importance to all of us who are in a position to work with or manage others.

This point was thrown into sharp focus at a recent National Management Association seminar by Dr R J Agnew of the University of Pittsburgh.

Paycheck and fringe-benefit rewards, says Dr Agnew, can only be realized, can only be cashed in, *outside the job situation.* Consciously or unconsciously, the job becomes only a means to an end, a sort of penalty period that must be lived through to earn the means to satisfy our needs, whether they be physical or psychological.

If we engineers and managers want to win willing and co-operative work from our associates and subordinates we can't depend exclusively on rewards that are cashed in outside the job situation. We must move as many rewards as possible into the job itself, make working in our organization a means of satisfying needs directly.

These needs will vary from person to person. One man will put high value on recognition while another's greatest need may be for opportunities to work creatively. Our problem as managers is to learn to understand the forces that motivate the men we work with and to find ways for them to achieve solid satisfactions *within the job situation.* When we do that we build men, and in building men we build a topnotch organization.

Here's Why

Masoneilan Model 4811 D. P. Transmitters

Give You Top Performance

These essential features of the Masoneilan design assure optimum performance in differential pressure, flow or liquid level applications . . .

- **Accuracy** within 1% of range span, plus fast response, and minimum hysteresis and nonlinearity. There is no distortion due to outside forces acting on cover and damping is built in at measurement source. Static pressure effect is less than 0.2% per 100 psi change.
- **Rugged Construction** provides complete protection due to overload, negative differential or overranging. Rigid mounting for horizontal or vertical surfaces. All working parts exposed to process fluid are made of Type 316 stainless steel. Extra heavy beam avoids bending.
- **Versatility** — range adjustable between 20 and 200 inches of water; suppression up to 50 inches. Suitable for differential pressure, flow, or liquid level applications.

Investigate all the advantages these improved transmitters offer you. Bulletin with full specifications sent on request.

MN7-40

MASON-NEILAN

Division of Worthington Corporation

33 NAHATAN STREET, NORWOOD, MASSACHUSETTS

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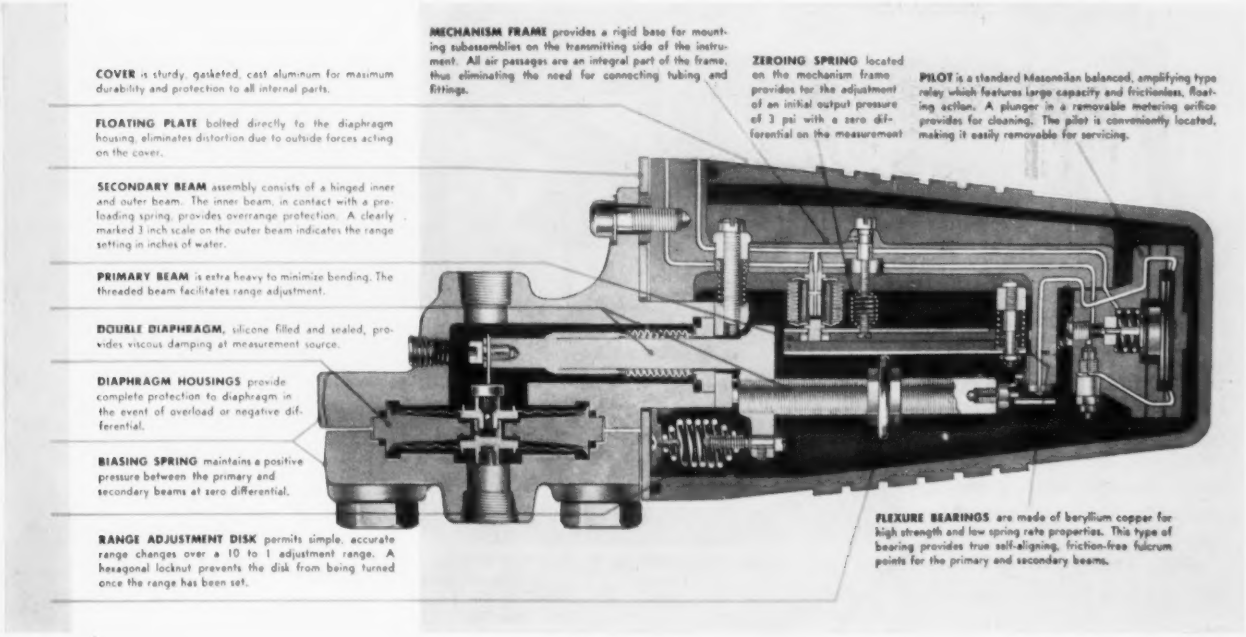
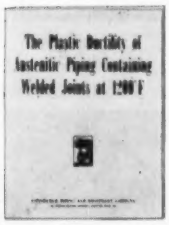

COVER is sturdy, gasketed, cast aluminum for maximum durability and protection to all internal parts.
FLOATING PLATE bolted directly to the diaphragm housing, eliminates distortion due to outside forces acting on the cover.
SECONDARY BEAM assembly consists of a hinged inner and outer beam. The inner beam, in contact with a preloading spring, provides overrange protection. A clearly marked 3 inch scale on the outer beam indicates the range setting in inches of water.
PRIMARY BEAM is extra heavy to minimize bending. The threaded beam facilitates range adjustment.
DOUBLE DIAPHRAGM, silicone filled and sealed, provides viscous damping at measurement source.
DIAPHRAGM HOUSINGS provide complete protection to diaphragm in the event of overload or negative differential.
BIASING SPRING maintains a positive pressure between the primary and secondary beams at zero differential.
RANGE ADJUSTMENT DISK permits simple, accurate range changes over a 10 to 1 adjustment range. A hexagonal locknut prevents the disk from being turned once the range has been set.
MECHANISM FRAME provides a rigid base for mounting subassemblies on the transmitting side of the instrument. All air passages are an integral part of the frame, thus eliminating the need for connecting tubing and fittings.
ZEROING SPRING located on the mechanism frame provides for the adjustment of an initial output pressure of 3 psi with a zero differential on the measurement
PILOT is a standard Masoneilan balanced, amplifying type relay which features large capacity and frictionless, floating action. A plunger in a removable metering orifice provides for cleaning. The pilot is conveniently located, making it easily removable for servicing.
FLEXURE BEARINGS are made of beryllium copper for high strength and low spring rate properties. This type of bearing provides true self-aligning, friction-free fulcrum points for the primary and secondary beams.

ALL IN A DAY'S WORK at *Pittsburgh Piping*

STAINLESS STEEL AUTOCLAVE and VOLUTE
Shop Fabricated

by *Pittsburgh Piping*

This autoclave and volute assembly is typical of the work that goes through Pittsburgh Piping shops. Fabricated of Type 304 Stainless Steel, it is complex in design and is built for high pressure, high temperature service. This type of fabricating is a "natural" for Pittsburgh Piping. We pioneered the application of austenitic steel piping materials for central stations operating at 1050°F. and above, and fabricated the piping for the world's first atomic-powered submarine and central station. Highly specialized methods, machines, and apparatus have been developed and are employed in this work. Use them on your high temperature, high pressure piping jobs.



WRITE FOR YOUR COPY

This bulletin reports an intensive investigation into the problem of main steam piping materials and gives data on the stress rupture characteristics of Types 316 and 347 stainless steel piping adjacent to welded joints.

Promoting Progress ***IN POWER AND PROCESS PIPING***

Pittsburgh Piping **AND EQUIPMENT COMPANY**

158 49th Street—Pittsburgh, Pa.

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New Orleans ..... P. O. Box 74
New York ..... Woolworth Building

PP-32

B G A SKROTZKI
Associate Editor in Charge

a Today's Development report

This month Duquesne Light Co plans to install a fire-resistant lubricant in an operating steam turbine-generator. Their findings will strongly influence the future of . . .

F-R turbine lubricants

- Today's watch-and-wait attitude by many utility company managements exists mainly because they're groping for adequate answers to their technical problems

- There has been a marked absence of basic research into many of the unique problems associated with the use of synthetic fluids as turbine lubricants

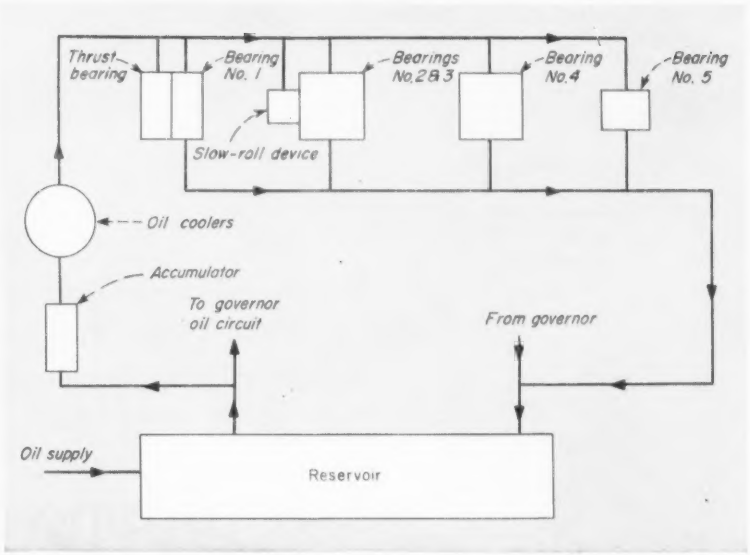
- One thing is sure; utility operators recognize the real advantages in truly fire-resistant lubricants. And they stand ready to adopt them, even at their higher cost

By J J O'CONNOR
Managing Editor

When Duquesne Light Co took steps last month toward using a synthetic fire-resistant fluid as the lubricant in an operating steam turbine-generator, they chalked up another milestone along the long road toward eventual adoption of the synthetics by the utility industry. Although there is much yet to be learned about such fluids before the goal is reached, Duquesne is in a particularly fine position to take the step they did. They have several years' experience with synthetics as lubricants in turbine-driven boiler-feed pumps. Also, the machine selected for the test is an old-timer, installed back in January 1925, so the risk is small. Their decision will see the utility industry, as well as synthetic-fluid suppliers, keeping close watch on their progress.

General interest in F-R turbine lubes goes hand-in-hand with climbing steam temperatures and the trend toward larger units. Operating men are keenly aware of the potential fire threat resulting from a lube oil line break or a pressure gage or thermometer leak that might occur close to steam lines. This acute awareness of the problem was further stimulated back in

FLUSHING BATCH will not be used in the Duquesne test, says R G Knight, *above*



PACKING AND GASKET MATERIALS will remain uncharged in Duquesne's Colfax unit. And since fluid OS-81 does not attack micarta, the insulating spools in lines are OK

'The possible harmful effect of synthetic F-R lubricants

1952 when Dr S F Whirl of Duquesne Light Co drew the utility men more closely into the synthetic-fluid picture. At that time, speaking for a division of the EEI Prime Movers Committee, Whirl got the chemical suppliers, oil companies and utility operating men thinking realistically in terms of F-R lubes. Since that time many tests have been run in boiler-feed turbine-pumps and in one operating turbine-generator.

Problems posed in recent years have been many. The big one yet to be resolved centers about the possible harmful effect of synthetic fluids on generator insulation. Lab tests, consisting of taking a typical asphaltic type electrical insulation and immersing it in a beaker of synthetic fluid, show the insulation is definitely harmed. But similar tests with improved insulations supplied in newer machines show more promising results. Newer insulations—typical one being composed of mica and a synthetic resin binder — are relatively unaffected.

True, the bearing lubricant should never reach the generator insulation if seals and tolerances are in top condition. But long operating experience shows some oil does get onto the windings. And we have every reason to expect similar leakage with proposed synthetic fluids.

For existing machines with older asphaltic type insulation, one solution might be spray-coating the stator and rotor windings with a material impervious to synthetic fluids. But, though we know some insulations soften when immersed in the fluid, little is known about what to expect when a small amount of the fluid is sprayed or fogged onto the windings—as is the case in practice.

Foaming of the fluid when in service has been a headache. Right now the fluid suppliers feel this problem is licked, but further field trials will tell the final story. Most promising results, foamwise, have been in the boiler-feed turbines at Duquesne Light. Con Edison, in contrast, have yet to be convinced that foaming is licked; they are running lab tests on all available F-R fluids.

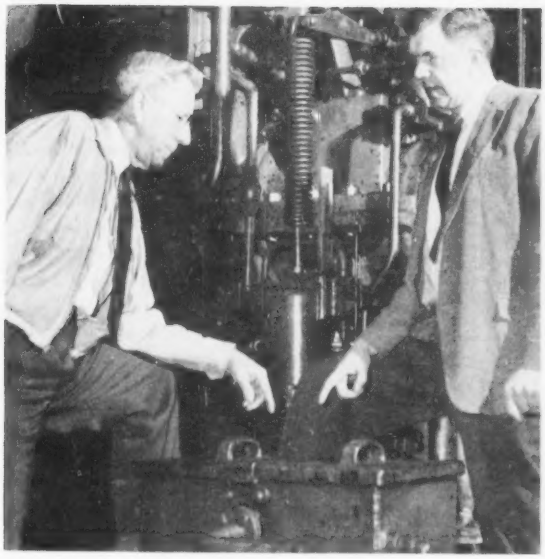
To get perspective, let's go back a few years and review what has been done in field testing.

Kickoff installation in a turbine-driven boiler-feed pump came in September 1954 when Con Edison (N.Y.) installed Socony Mobil's RL-265-A at their Waterside station. The chlorinated phosphate-ester fluid replaced petroleum oil in a GE turbine rated at 1537 hp, 4650-rpm, with 200-psi steam at the throttle. Turbine drove a Byron-Jackson feed pump having 470,000-lb-per-hr capacity at 1800-psi discharge. Lube systems in both turbine and pump were independent of each other.

Before adding the F-R fluid, turbine oil system was flushed with Bendix cleaner, an alkaline material. Next, it was flushed with two batches of clean turbine oil. After each flushing, oil lines were blown back from bearings and oil reservoir and swabbed thoroughly. Final step was to fill reservoir with the chlorinated phosphate ester.

Oil-conditioning setup was installed since this turbine had a record of water leaking into the lube system from turbine glands. The turbine-pump operated about nine months with the synthetic, chalking up 5322 service hours. Foaming was quite severe throughout the test.

Foaming cause was explained as centering around the water and dirt in the fluid. A C Stutson of Socony pointed out that with petroleum oils, which are lighter than water, centrifuging causes heavier dirt to go into



OIL CONDITIONERS, in the form of fuller's earth and a centrifuge, may be needed once the fire-resistant lubricant is installed

STATION CHEMIST will inspect the fire-resistant fluid and take daily samples during the first week; less frequently thereafter

on generator insulation is a problem yet to be resolved'

the water and be removed from the oil. The reverse is true with synthetics. Since phosphate-ester fluid is heavier than water, dirt remains in and fails to come out when water is removed.

Presence of finely divided dirt in a fluid tends to stabilize foaming. So even though defoamers were tried at Con Edison, their effectiveness under the excess water conditions was limited to about two or three weeks. Remember, a defoamer's effectiveness hinges on the fact that it doesn't remain in the solution but seeks the interface. Excessive water in this unit, which had to be frequently removed, reduced defoamer's effectiveness considerably.

Con Edison had another go-around with a boiler-feed turbine-pump at their Sherman Creek powerhouse. Here, a Celanese phosphate-ester lube, Blend 998A, was used. Once again Con Edison reported foaming. They also reported thrust-bearing rubbing, but did not pin it down to the synthetic lubricant. Right now Con Edison is on the verge of still another test in another boiler-feed turbine-pump.

Duquesne Light Co jumped into the boiler-feed pump field-testing arena with Monsanto Chemical Co's fluid, tagged OS-58-1. This lubricant is an oily amber-colored liquid having, as you'd suspect, a higher specific gravity than water. It was compounded of a phosphate ester, halogenated hydrocarbons and suitable additives. At the ASTM Technical Committee C meeting in Houston last February, Dr Whirl went on record to the effect that foaming had cropped up during early weeks of the test. However, foam disappeared with application of a defoamer at intervals. Since then the lubricant has performed well and there are no

Here are Duquesne Light's seven steps for installing F-R lube

1 While petroleum oil is still in the turbine system, install a fuller's earth filter ahead of the centrifuge on by-pass. Keep turbine operating with this setup until lab tests indicate oil and system are clean

2 Drain petroleum oil from reservoir into a storage tank. Then clean all accessible surfaces by wiping

3 Drain oil lines, low points, bearing housings, coolers, etc

4 Install a floating suction in the reservoir to supply the purification setup

5 Re-pipe centrifuge, reversing water and oil discharges. (F-R fluid is heavier than water)

6 Install the fuller's earth purifier so it or the centrifuge, or both, can be used at one time

7 Install the F-R fluid and place turbine in service. Check operation closely

'Lab testing has been moving ahead with field tests. Yet, it's an area where there is much to be done'

plans to remove it from the unit now.

Still another unit at Duquesne (another boiler-feed turbine-pump) was converted to Monsanto's OS-81 about 10 months ago. It has operated to date without problems.

Celanese Corp have contributed their share in the way of field tests. Their Blend 998A has racked up many months in two turbine-driven compressors; one a primary-air compressor, the other a booster. The primary-air system incorporates a 5330-hp 5550-rpm turbine while the booster section has a 1630-hp 10,760-rpm turbine. *Compressors in both systems used the same lubricant as their drive turbines.* A Celanese spokesman reports the test a success, and it will be continued. A similar phosphate-ester fluid, Blend 995A, has been supplied by Celanese and used as the pump lubricant in a motor-driven boiler-feed unit.

Turbine-generator test, the first on record with a F-R lubricant, was made some years back in Commonwealth Edison's Northwest station. Socony Mobil supplied their RL-265-A for the test run in the 35,000-kw machine. Trouble cropped up fast, but not with the fluid. In an over-earnest effort to clean the lubrication system, metal particles used as a scour were left in the system. They worked their way into the bearings.

Last year Standard Oil Co (Ind.) furnished a basically different F-R lubricant for use in the same Northwest station unit. This fluid is described by Standard as "a mixture of halogenated aromatic and other hydrocarbons, plus chosen additives which enhanced the oxidation stability, nonrusting and defoaming characteristics of the lubricant." Some foam appeared early in the test, but was kept under control with a defoamer.

Early plans in this last Commonwealth test called for running the lubricant about 10 weeks, just prior to scrapping the unit. But, shortly before this date was reached, bearing trouble developed. Quick checking indicated the fault was not linked to the lubricant. Commonwealth did not report the cause of the bearing difficulty. All parts of the lube system were found clean with no evidence of deposits.

Recent move on Duquesne's part to run a test with Monsanto's OS-81 in an operating steam turbine-generator calls for a procedure such as outlined on p 75. The unit to be used is No. 3 in their Colfax station. It was placed in service January 22, 1925. Manufactured by Westinghouse, it operates at 265-psi steam pressure, 625 F, and is rated 30,000 kw at 1800 rpm.

Lab testing has been moving ahead with field tests. Yet, it's an area where there is much to be done. If it were possible to manufacture a synthetic lubricant with all the properties of petroleum, yet having a suitable degree of fire resistance, there would be little problem today. But this is not the case.

As pointed out by G H S Snyder of Socony Mobil (ASTM meeting, Sept 17, 1956 in Los Angeles) a wide variety of test methods is being used for evaluating F-R lubricants. This points up the pressing need for (1) standardization on interpretation as well as techniques (2) new tests to measure the various properties of F-R lubes. You can rightly question the straight adoption of present petroleum tests for the synthetic fluids. An ASTM study group is at work probing this area.

Present ASTM flammability tests for petroleum can be misleading in evaluating a test fluid. Example; benzine has a flash point of 12 F and an autogenous ignition temperature about 1200 F. In contrast, a petroleum turbine oil has a flash point of 350 to 450 F and an autogenous ignition temperature of about 700 F. Yet neither of these fluids would be considered fire resistant. Following are some tests which attempt to simulate field-service conditions.

How F-R phosphate-ester lubes affect packings

Give seals and packings close scrutiny before installing a F-R turbine lubricant. E F Houghton & Co, suppliers of both F-R lubes and packings, came up with the following as a result of swell-tests:

1 Butyl rubber is OK with nonchlorinated fluids

2 Buna-N compounds are not compatible

3 Fabricated rubber packings can be used, but are short-lived

4 Rubber-impregnated leather packings stand up well

Who's who in F-R turbine lubes

Fluid suppliers

Celanese Corp of America
E F Houghton & Co
Monsanto Chemical Co
Shell Oil Co
Socony Mobil Oil Co
Standard Oil Co (Ind.)

Fluid users, to date

Commonwealth Edison Co
Consolidated Edison Co
Duquesne Light Co

Dr S F Whirl: An early leader in the search for F-R lubes

In tackling a study penetrating into the practicality of F-R turbine fluids, the Edison Electric Institute's Prime Movers Committee some six years back kicked off a program that has fanned a long-smoldering interest by the utility industry.

As chairman of the Committee's segment spearheading the project, Dr S F Whirl, Duquesne Light Co, led off with a close scrutiny of the literature and patent situation. With that squared away, he drafted a letter to turbine builders and lubricant suppliers. His aim: awaken interest in the old problem of ferreting out a lubricating fluid with plus values of petroleum oil yet having a higher degree of fire resistance.

Reaction to the letter was mixed. Where fertile ground was reached, positive steps were taken that led directly or indirectly to the position the industry now occupies—several promising fluids on tap, each with its own set of problems awaiting answers in practical operation.

Hot-manifold ignition test calls for dripping a measured quantity of fluid within a specified time onto a hot metal surface kept at 1300 F. *Flammability spray test* uses a stream or spray of the fluid under pressure, subject to various ignition sources. Ignition, direction and amount of flame propagation is studied. *Pipe-cleaner test* utilizes a simple pipe cleaner soaked in test fluid and cycled through a bunsen flame until a self-sustaining flame is maintained. *High temperature-pressure ignition spray test* is one where the fluid is atomized at 1000 psi into an oxyacetylene flame. *Asbestos-tape flame transfer* uses the lower end of an asbestos tape, soaked in the fluid, and placed in contact with a gas-oxygen flame. A careful study is made of flame propagation.

For a more detailed analysis of the test evaluation picture, read "Laboratory evaluation of fire-resistant fluids" by Snyder, Manley and Messina, as found in the ASTM Special Technical Publication No. 211. (ASTM, 1916 Race St, Philadelphia 3, Pa.)

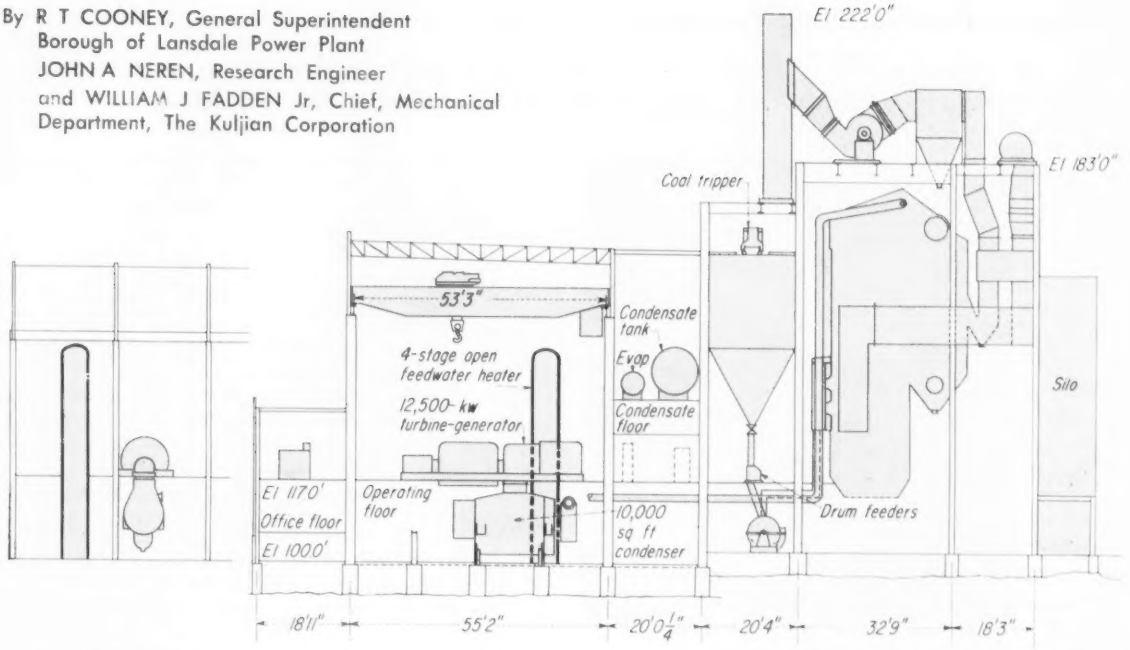
New fluids available today, with the exception of the F-R lubricant supplied by Standard Oil Co (Ind), are broadly classified in the phosphate-ester class. In general, these lubricants have dropped the VI (viscosity index) improver. The reason often given for this move was the decrease in fluid viscosity resulting from shear breakdown of the polymer thickener. Also, some suppliers are leaving out the chlorinated material in their newer formulations. The Navy's requirements in this area are probably one good reason for this move. Some feel the chlorinated material was added simply to aid the fluid in passing the ASTM oxidation test. The air-retaining tendency of fluids containing polymer is another reason for shucking VI improvers.

Celanese Corp's present fluid is a straight phosphate ester, labeled Cellulube. It is supplied at viscosities of 220 or 150 ssu at 100 F. The E F Houghton phosphate-ester lubricant has a viscosity of 227 ssu at 100 F, an autogenous ignition point over 1200 F and a specific gravity of 1.15 at 60 F. Monsanto Chemical Co's OS-81 has an absolute viscosity designed to match, at 180 F, the viscosity of a top-quality petroleum turbine oil having 150 ssu at 100 F. From this base point the viscosities at other temperatures were allowed to fall where they would.

Monsanto stresses the importance of the turbine-oil oxidation stability test. After 3000 hr in their labs, OS-81 held acidity unchanged, light color remained, trace of sludge, copper and iron coils in good condition. Monsanto concludes, on the basis of their tests, that OS-81 is more stable than a top-drawer double-inhibited petroleum turbine oil. Similar data was not available for other fluids.

Shell Oil Co has phosphate-ester lubricants labeled SFR-B (150 ssu at 100 F) and SFR-C (220 ssu at 100 F). They report no field tests to date in operating steam turbines. Socony Mobil's latest fluid, a phosphate ester with chlorinated material and without a VI improver, is called RL-309-A. Field trials are planned for the near future. Standard Oil Co (Ind.) does not have a phosphate-ester fluid for turbine use. They are continuing research with the type installed in Commonwealth Edison. In the near future you will probably see a F-R fluid being marketed by a British oil supplier and operating in a central station in England.

By R T COONEY, General Superintendent
Borough of Lansdale Power Plant
JOHN A NEREN, Research Engineer
and WILLIAM J FADDEN Jr, Chief, Mechanical
Department, The Kuljian Corporation



New 12,500-kw turbine-generator at Borough of Lansdale, Pa., Municipal Power Plant features unit design with all steam coming from one 150,000 lb-per-hr steam generator. K-F feedwater heater with 4 stages stands 44-ft high next to turbine

To counteract today's and tomorrow's squeeze on power generating costs calls for creative engineering. Here, a bold forward step is taken toward lowered installed plant costs as . . .

Borough of Lansdale

The fifth unit being added at the Borough of Lansdale (Pa.) Municipal Plant will about double system capacity. The 12.5-mw unit will be supplied 900 psig 900-F steam from a single 150,000 lb-per-hr steam generator.

The existing plant has four turbine-generators, rated at 1000-, 3000-, 3500-, and 6000-kw respectively. Two 40,000 lb-per-hr and two 80,000 lb-per-hr boilers feed the four turbines. The relatively large new unit uses steam conditions that meet the needs of modern economics of power generation. The plant equipment table, p 80, lists the principal companion plant components. Fig. 1 shows the general unit arrangement.

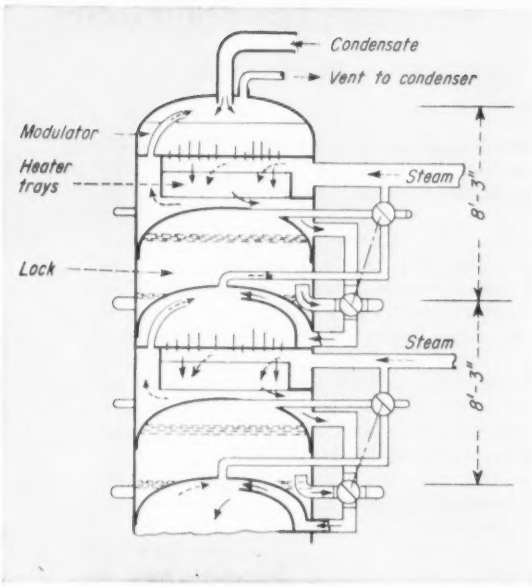
New design. In reaching for the ultimate in overall economy the new unit pioneers in the area of feedwater heating. Four extraction openings in the turbine will feed steam to four stages of direct-contact feedwater heating, all contained in a single vertical cylindrical vessel. A system of locks controlled by pairs of 4-way valves connects the open-heater stages. This K-F design was announced in "New power-plant idea—feedwater heating towers" by H A Kuljian and W J Fadden Jr, POWER, July 1956, pp 80-83.

The new integrated K-F heater to be installed at Lansdale incorporates improvements developed during the last two years. These concern primarily the control of feedwater flow through the unit. Fig. 3 shows the schematic layout of an 8-stage heater designed by The Kuljian Corporation. The Lansdale heater will have a similar layout but only four stages.

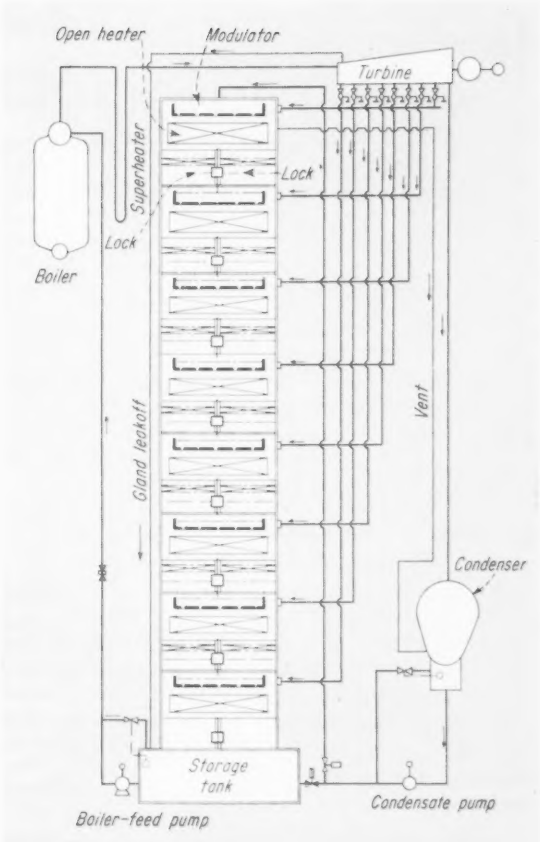
Heater layout. The heater eliminates the need of interstage transfer and drip pumps and drain controls. All stages use standard tray type open-heater arrangements. Feedwater flows by gravity to successively higher-pressure stages. Placing the heater next to the turbine shortens all piping runs, Fig. 1.

In Fig. 3 the low-pressure stage stands at the top and the highest-pressure stage at the bottom of the tower. The hot-feedwater storage tank is part of the heating tower.

All eight stages are alike; each contains three main elements: (1)



2 Two 4-way valves, mechanically coupled, control feedwater flow automatically and lock pressure of each open heater stage



3 Eight-stage K-F heater stands about 68-ft high with feedwater flowing downward, under gravity flow without pumping

plans to use new feedwater heater

modulator (2) open heater (3) two locks with transfer valves. The stages differ only in shell wall thickness which increases with steam pressure.

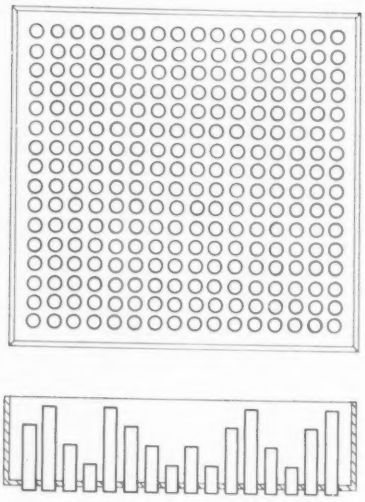
In each stage an upper chamber contains the modulator which discharges to the heater tray below it, Fig. 2. The lower chamber is divided into two equal compartments or locks. The 4-way valves allow a heater stage to drain into one lock while the companion lock drains by gravity into the higher-pressure-stage modulator below.

Since the condensate pump discharges water to the first low-pressure stage at a rate proportional to the unit load, the first stage does not need a modulator. The condensate need only be uniformly spread to the tray stack by a distributor. A modulator, however, can also act as a distributor and so Fig. 2 and 3 show a modulator in the first stage.

Water flow. The main condensate pump discharges the cold feedwater from the condenser hotwell to the modulator of the lowest-pressure stage at the tower top. From here the feedwater with the condensed heating steam added in each stage flows by gravity through all stages; its pressure and temperature increasing in each stage.

The modulator of each stage, Fig. 4, controls the feedwater discharge rate in proportion to the instantaneous volume of water it holds. This is done by the system of several different lengths of pipe nipples, of equal diameters, rolled in the bottom (tube sheet) of the modulator.

Feedwater discharges through these nipples to the open-heater trays below at a rate depending on the water level in the modulator. At low flow rates only the shortest pipe nipples can discharge to the trays below. As the water level rises with increasing flow, the longer pipe nipples successively submerge and provide more area for water flow; the shorter nipples also pass more water because of the higher head. This setup smooths out flow rate to the heater trays at all load levels on the turbine. This keeps all parts of the heater tray stack active to give more efficient heating and deaeration. It also avoids steam short-circuiting. **Turn page**



4 Modulator has several different lengths of nipples to control the water flow

PRINCIPAL POWER-PLANT EQUIPMENT

Lansdale, Pa. Municipal Electric Plant—Unit 5

Turbine-generator, 1 ..... Westinghouse Electric Corp
12,500/15,625 kw, 850 psig, 900 F, 2 in. Hg backpressure, 4 extraction points, 4160-v 3-ph 60-cycle air-cooled generator, 125-v exciter

Condenser, 1 ..... Maryland Shipbuilding and Drydock Co
10,000 sq ft surface, 7/8-in. OD, 18 BWG admiralty tubes, 20-ft long, 2-pass, 2-stage twin-element steam air ejector, two 300-gpm condensate pumps, two 6000-gpm circulating-water pumps, hog jets, circulating-water priming jet, deaeration to 0.03 cc O_2 per liter

Steam generator, 1 ..... Riley Stoker Corp
150,000 lb per hr, 900 psig, 900 F, 2 drum, bent tube, 125-hp f-d fan, 200-hp i-d fan, self-supporting steel stack, spray type superheat control, 86.4% efficiency

Coal pulverizers, 2 ..... Riley Stoker Corp

Air heater, 1 regenerative, Ljungstrom ..... Air Preheater Corp
315-F air exit temperature

Dust collector, 1 mechanical ..... Pratt-Daniel Corp

Combustion control ..... Bailey Meter Co

Feedwater heater, 1 ..... Cochrane Corp
Type K-F, 4 stage, open, direct-contact tray type, 5 ft 6 in. dia, 44-ft high (invented by H A Kuljian and W J Fadden Jr)

Evaporator, 1, 6200 lb per hr ..... Griscom-Russell Co

Boiler-feed pumps, 2 ..... Byron Jackson Pumps Inc
1 turbine-, 1 motor-driven, 350 gpm each, 1100-psig discharge

Ash-handling system ..... Allen-Sherman-Hoff Co
Vacuum, dry type, 50-ton silo

Crane, 40-ton ..... Shepard Niles Crane & Hoist Corp

Structural steel, roof decking, flooring ..... Frank M Weaver

Condensate tank, 11,410 gal ..... Aluminum Company of America

Circulating-water pipe ..... Lock Joint Pipe Co

Main and auxiliary switchgear, 2330-, 440-v ..... Federal Pacific Electric Co

Reactors, 4 ..... Westinghouse Electric Corp

Desuperheating station, reducing valves ..... Republic Flow Meters Co

Each stage has two sets of 4-way 4-port rotary transfer valves connected mechanically to act simultaneously, Fig. 2. One valve alternately connects the locks to the stage steam line, or to the higher-pressure stage below; the other valve alternately shuts off one lock water discharge while it opens the other to the modulator of the stage below.

For example, at one position of the valves, stage 1 has water discharging from its modulator through the tray stack into the discharge nozzle below the tray in the tower wall, Fig. 2. The 4-way water valve directs this water into the lefthand lock which is under stage 1 pressure because the 4-way steam valve connects it to stage 1 steam line.

At the same time the 4-way water valve lets the righthand lock drain to the modulator of stage 2 by gravity flow. It can do this because the 4-way steam valve connects the lock with the higher-pressure steam filling stage 2. Pressurizing the water in the righthand lock by simply setting the steam valve eliminates the need of pumping to the higher-pressure stage, gravity flow moves the water.

The valves of a pair snap into their alternate position at the same time at a set time interval so righthand lock depressurizes to the pressure of stage 1, the small puff of excess steam being quickly condensed by the feedwater. The feedwater of stage 1 then accumulates in the righthand lock under the pressure of stage 1.

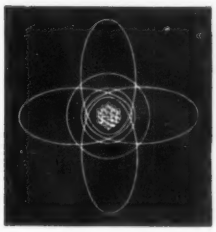
At the same time, steam pressure above the water in the lefthand lock rises to that of stage 2. The lefthand lock immediately starts discharging its accumulated feedwater by gravity to the modulator of stage 2.

All the stages work in the same sequence of alternately accumulating stage feedwater in one lock and then discharging it to the higher-pressure stage below. The feedwater steadily increases in pressure and temperature as it flows down through the tower.

Reduced steam from boiler drum keeps pressure in the storage tank at the tower bottom above saturation so the boiler-feed pump won't become steam bound; the pump always runs under a net positive suction head.

Valve operation. The rotary transfer valves operate on a timed cycle. For any one stage, as one lock fills the other empties. At the end of the cycle the fill-empty functions reverse to start the next cycle. Feedwater flow through the modulator varies somewhat during cyclic changes; this makes the bleed steam flow from the turbine vary in proportion. If valves of all stages operated together, the change in steam flow would be noticeable at the turbine throttle. By operating the valves out of phase with each other, total steam-flow change stays at a minimum and well within limits pre-

(*Continued on page* 130)



Nuclear notes

By B G A SKROTZKI, Associate Editor

Argonne's EBWR at Lemont, Ill., takes another jump in sustained maximum heat output; originally designed for 20 mwt it now has been boosted to 61.7 mwt with the same core. Designers feel that replacing the 4-ft core with a more heavily spiked 5-ft core would raise capacity to 100 mwt.

Radioisotope price slash will aid finding new uses and expand present applications. New prices are only about 10% of the former level for cesium-137, promethium-147, cerium-144, strontium-90 and technetium-99. New prices anticipate production from the new Multicurie Fission Product Pilot Plant at the AEC Oak Ridge National Laboratory in Tennessee, to start this summer. Cesium-137 works in industrial radiography, density gages and liquid-level gages. It may also be used for induction of chemical reactions, polymerization and sterilization of drugs and surgical supplies. Promethium-147 and strontium-90 are used in self-luminous sources and atomic batteries. Strontium-90 also works in thickness gages. High cost had restricted use of cerium-144 and technetium-99, but the latter shows promise as a corrosion inhibitor for metals.

Electric utilities plan to spend about $500 million on nuclear power projects, says J W McAfee, president of Union Electric Co and Edison Electric Institute. Three atomic power plants were completed last year, four are under construction, and two others are being planned. About $250 million of the total will be spent by the end of 1959.

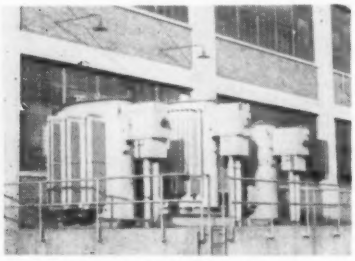
Underground atom bomb blast last September 19 at AEC's Nevada testing grounds was dubbed the Ranier detonation. The 1.7 kiloton shot blasted off in a 6x6x7-ft chamber at the end of a horizontal 1900-ft tunnel in a volcanic rock mesa. The chamber was about 900 ft under the mesa surface and 800 ft from the steeply sloping hillside. Shock was detected by seismographs in Alaska about 2500 miles away. Dislodged rocks rolling down hillside raised cloud of dust on mesa, but no radioactivity escaped to atmosphere. The shot automatically sealed the tunnel in a "hook" formed by two 180-degree turns near the detonation chamber. The blasted rock filling the tunnel held the explosion products in the chamber.

Explosion effects first caused the chamber to expand to a spherical cavity about 110 ft in diameter. The inner surface of this cavity was formed of melted rock resembling glass, so it consisted of a "glass" shell. Soon after, the shattered rock above the shell crashed through and filled the glass-lined cavity and formed another cavity 385 ft higher up, about 500 ft below the mesa top.

Hopeful theories had been advanced that the terrific pressures and temperatures might form precious gems—but none were found. The shot produced about 50,000 tons of broken permeable rock and another 400,000 tons of crushed impermeable rock. This effect could be used to break up ore bodies in mining, and to break up oil strata to free crude oil trapped in nonporous rock formations. Heat from the blast might make oil flow more freely through rock formations.

Unexpected result was to find rock temperatures of 90 to 190 F within about 60 ft of ground zero of the underground blast, 3½ months after it had been set off. This means that energy of blast could be used to produce steam for temporary short-term needs; trapped radiation helps to sustain heat production.

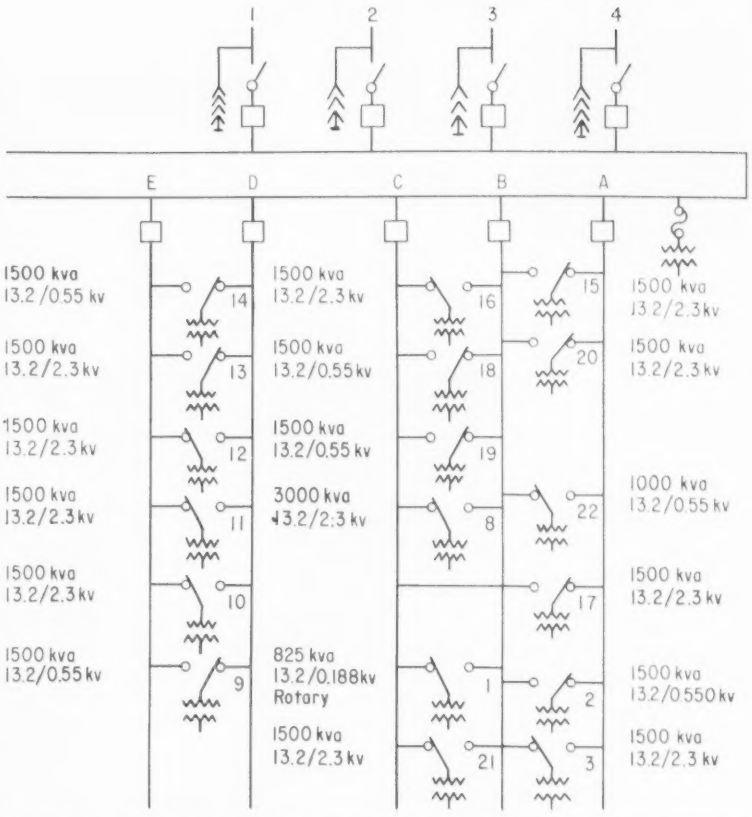
PRIMARY SUBSTATION with incoming lines, outdoor breakers and batteryroom



2300-V TRANSFORMERS with primary selector switch, 13.8-kv feeders from manhole

400-KW MOTOR-GENERATOR SET and controls are part of 250-v dc distribution

By C E BLUMENAUER, United States Rubber Company



AC PRIMARY DISTRIBUTION SYSTEM has four utility feeders, divides load among five plant feeders. Primary selection is provided to protect the continuity of critical loads

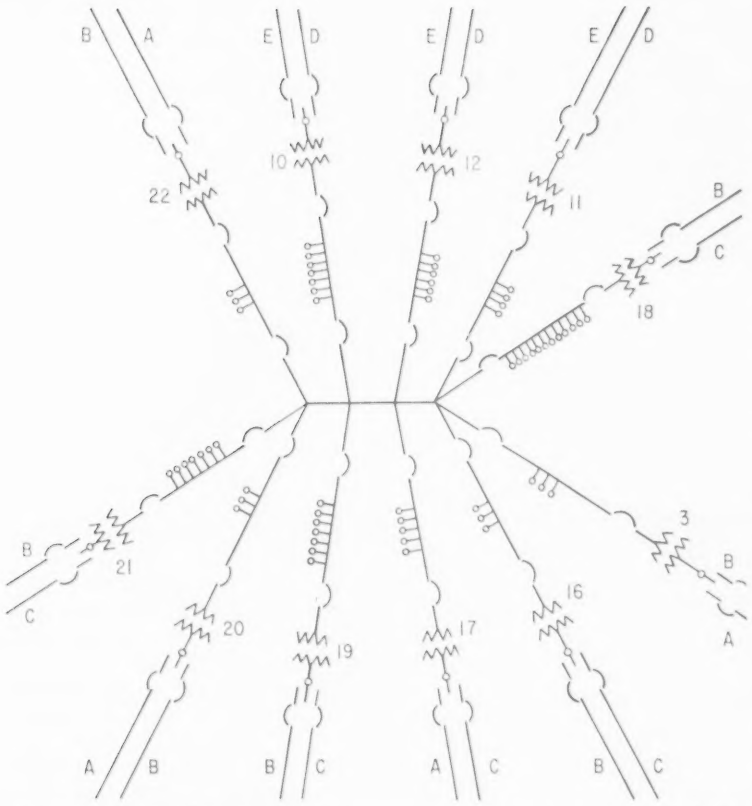
Continuity is key to our electrical

In 1940 the United States Rubber Company purchased its Chicopee Falls, Massachusetts plant from a company which had gone into bankruptcy. The plant was run down, so management set up a program to modernize all plant functions. This included $1,000,000 for the modernization of the electrical system.

The big problem was where and how to start. We had a small station, with service coming in across the river. But, the old building was practically falling apart. Its circuit breakers were unrated at that time, of 25,000 or 50,000-kva interrupting capacity. Naturally that wasn't enough. Many of the wires, feeders and control cables were hanging from the ceilings or down the wall, and temporary connections prevailed.

First consideration was load requirements, including possibilities for about the next 20 years. We figured 15,000 kva would do the trick for at least 10 years, and we could allow for another feeder and breaker at the station for more power to grow. We calculated possible exposure on the system to be 430,000 kva, taking into account the length and size of feeders, utility company's capacity, connected load, etc. The situation called for purchase of 1200-amp 500,000-kva interrupting capacity breakers. Since we needed both capacity and continuity, we decided on four incoming private lines and five outgoing feeders, diagram, above.

Voltages which would be most efficient had to be determined. So, we figured amount of power needed for each voltage. The most economical transformer locations required consideration of voltage regulation, feeder copper needs, locations for operation, power needs and possible expansion in that area. Since the plant was operating on 2300 and 550-volts ac, and 250 and 125-volts dc, we stayed with these voltages as a basic system. Reasons for this decision were: (1) The existing high voltage was 2300 volts, permitting use of much of the existing equipment. (2) Most other plants operating in our company use 2300 volts for their large motors, so we can utilize spare equipment of these plants if necessary. (3) New motors and control were purchased for 5-kv rating, reconnectible to 4160 volts if necessary. This also provided flex-



AC SECONDARY DISTRIBUTION was planned with continuity in mind. Tie feeders connect power unit locations through central star bus and circuit breakers at load units

system modernization

ibility with other plants in our company system. (4) Existing transformers and switchgear were 2300 volts, permitting modernization conversion to be done in small steps without seriously interfering with production.

The decision to remain with 550 volts was more or less mandatory since: (1) The plant had about 5000 motors operating on this voltage. The expense of rewiring these motors or purchase of new motors would have been exhorbitant. (2) Several of the power units had a calculated 75% of their projected life available. (3) Standard voltage in the New England area is 550 volts, and there is no premium or delay in the purchase of equipment with this rating. (4) Copper saving could be realized in the feeders of such a system over the 440-volt alternative. (5) By remaining with 550-volt system, most of the modernization work could be carried out without interfering with normal production. Since the 250 volt and 125/250-volt dc voltages are standard, no change was considered.

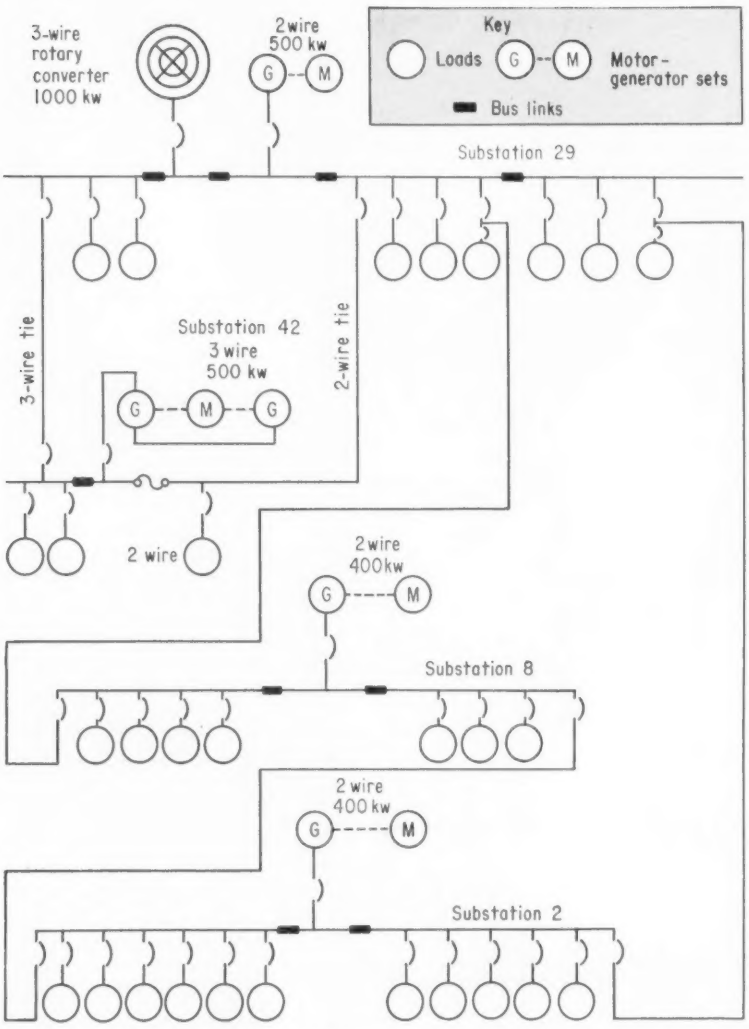
A new 3-phase 4-wire system was planned for lighting and small single-phase power loads. We standardized on 25-kva transformer units. All controls on motors operating 600 volts and below are 110 volts, supplied by control transformers connected directly to the motor power source. Fire and plant protection systems are set up in areas and relayed to a central point.

A future voice-paging system is expected to result in: (1) all personnel hearing key discussions in management-union talks where deemed necessary (2) management airing views to entire personnel (3) telephone savings on toll calls, etc (4) savings in management-personnel time when contacting others (5) reduction in machinery downtime (6) improvement in employee relations by transmitting music and special events over the system.

Power factor was brought into focus. Since it would benefit production to make the large motors synchronous, because mixing and milling operations would be more uniform if constant speed was maintained, we decided to use 0.80 leading motors. Studies showed that 125 hp was the breaking point. We now knew the number of 1500-kva transformers to be used on 2300-volt system and 550-volt system, so they were placed strategically about the plant area. Feeders were planned to insure a proper load balance, see sketches, at left, and on facing page.

Before we started to modernize, the power factor was 0.82; it is now between 0.98 and 0.99. That is a considerable saving when we talk about a $65,000 monthly electric bill. We have just finished redistributing our load factor, and are within about 1 megawatt demand on all three shifts. Result: a saving of about $50,000 a year.

Continuity was next consideration. At this plant, shutdowns are extremely costly because loss of one operation means loss of subsequent operations. This can cost up to $10,000 per hr, depending on the operation that fails. On the 13.8 kv side of the transformers, we have a high-voltage selector switch fed by two feeders. This switch was built with isolated connection chambers to permit work to be done on one feeder while the other supplies power. Motors of 125 to 1000 hp operate at 2300 volts. Most of the motors are 400 to 500 hp. The old system had open controls located in production area. We purchased modern metal-clad equipment and installed it in centralized control room away from the production spaces. The control rooms are kept locked to all except authorized personnel. This elimi-



DC DISTRIBUTION SCHEME also emphasizes continuity. Looped secondary bus has removable solid copper links. Faulted generator can be isolated, load shifted to other units

nated a safety hazard, made motors readily available for maintenance, removed motors from dirty locations and added valuable production space. It brought controls closer to the power units and shortened feeder lines, reducing failure possibilities.

With system continuity in mind, we chose a location as close to the physical center of the system as possible to place a common tap for the 2300-volt system, see sketch, p 83. Emanating from this point, we installed tie feeders to the various power unit locations and installed a circuit breaker at each location to connect it to the load bus. This saved one breaker on each transformer installation, eliminating a bus extension because of the circuit breaker. However, there is a common bus and if trouble develops the live cables feed only to the transformers whose circuit breakers are closed. No more than six transformers are ever paralleled at one time. Calculations, made on this basis, determined the interrupting capacity of the tie feeder breakers.

Advantages of system are: (1) Star design of the 2300-volt tie feeder system saves one circuit breaker per feeder, and offers continuity up to the total available capacity of all transformers that can be paralleled. It also offers continuity for the feeders of any transformers that cannot be paralleled, so they can be included in the system if properly interlocked. (2) System reaches all areas of the plant. (3) In the event of a sudden shift of load requirement, transformers other than the one used to feed this load can be brought into service to temporarily support the overloaded transformer. (4) Maintenance and repair costs are cut to a minimum since transformers needing work done can be switched off the system and maintained during regular working hours, rather than on overtime schedules. (5) Extreme simplicity gives economy in initial cost and future upkeep. (6) All equipment is standardized; can be shifted easily due to design changes or dire necessities.

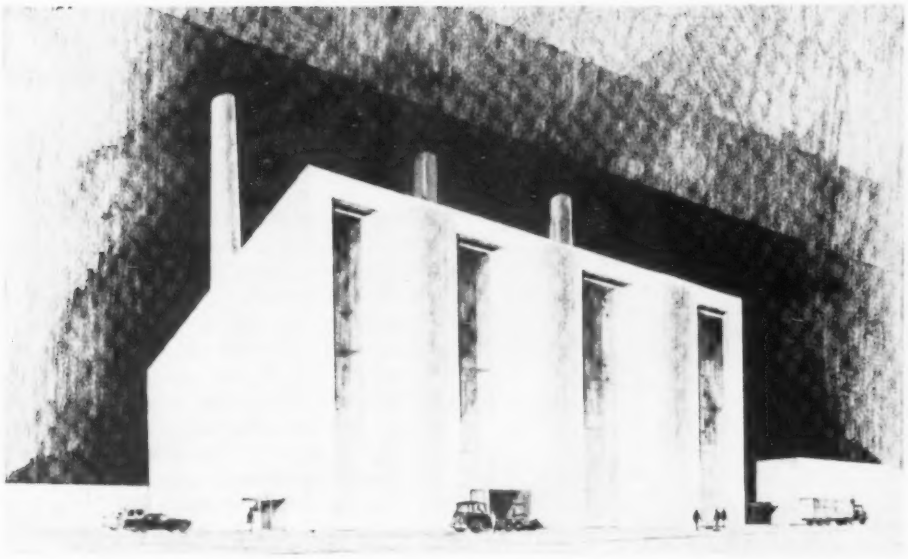
This system has already paid for itself several times over. First, when it became necessary to relocate temporarily a large block of plant load, and another time when the high side of a transformer failed.

Dc system planning for 125 and 250 volts made us survey the various loads as to required capacity and plant location. This helped determine the proper location and size for the proposed motor-generator sets; the old sets were to be discarded. We tried to keep the units as close to the loads as possible, thereby saving large amounts of copper in cables, feeders, etc. We used a m-g set at each of the four existing load-center sites in the plant.

In considering the type of unit, we investigated the m-g set, the mercury-arc rectifier and the mechanical rectifier. When these machines were planned, semiconductor rectifiers were not yet manufactured in needed capacities. The mechanical rectifier was in its infancy and used only where loads were constant. This unit is highly desirable since it is between 98 and 99% efficient. And, the manufacturer felt that commutation could be changed to permit varying loads up to 25% instantaneous overload with not more than 1 or 2% loss of efficiency. However, since production units which these rectifiers would serve were extremely vital, it was felt that we couldn't experiment.

Mercury-arc rectifiers were considered from the standpoint of efficiency. But, studies showed that the cost of supplying cooling water to

(*Continued on page* 177)



COAL SILOS become functional part of structure in hypothetical ultra-modern industrial boiler-plant design

Doing long-range fuel-cost planning? Take a look at these ideas for . . .

Handling coal in industrial plants

By Arthur J Stock*, President, Stock Equipment Co

Coal handling need not remain a knotty problem for small- and medium-size boiler plants. A new approach could do much in providing substantial improvements.

Such an approach wouldn't require a flock of radical changes in equipment design. We'd employ bunkers, silos, conveyors, elevators, etc as we have in the past. We'd simply arrange them differently and add a few new features. We'd get better-looking plants, better working conditions and add much to coal-handling equipment's efficiency.

Typical systems which have been in use for many years are: (1) Bucket elevator to belt or flight conveyor to overhead bunker. (2) For smaller plants, a silo, often located at the end of the boiler house, and a weigh larry taking coal to the boilers. (3) For still smaller plants (schools, commercial establishments, etc), a below-grade bin taking coal from trucks dumping through manholes. From the bin an inclined screw conveyor, monorail hoist or manual firing serves the boiler.

Let's see what we might do with some different arrangements. We aren't claiming that these suggested arrangements are fully engineered. Our purpose is to stimulate thinking about the overall coal-handling problem. If enough people do enough thinking, we're bound to come up with better systems that will cut coal-handling costs.

One objection to silo use is the unfinished appearance of silo and related coal-handling equipment. Also, if one looks outward from the boiler front, one can visualize the structure as having three walls; the building wall and two for the silo. This is really an extra wall, isn't it?

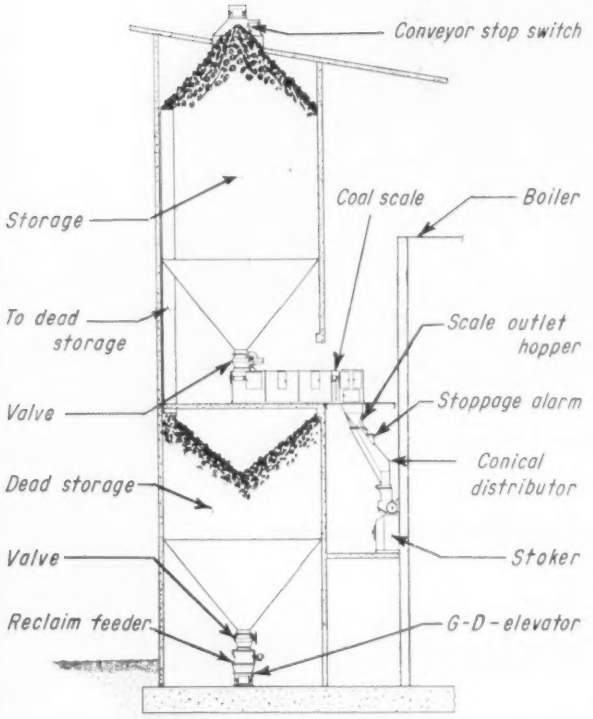
Suppose we move the silo inward toward the boilers until it actually becomes part of the boiler-house structure. If we're using more than one silo, space between them could be filled with glass or glass block giving good illumination to the interior. We'd save a lot of the building wall and the railroad spur could come in closer, too. Architect's drawing, above, shows how it would give the whole structure a striking appearance.

In this scheme, a gravity-discharge conveyor elevator, Fig. 1, would take coal from a track hopper, bring it to roof level and discharge into steel-bottomed live-storage area of any silo desired. Coal from silo would discharge through a valve to a long center scale, then go to a conical distributor over the stoker hopper. Overfilling live-storage area allows excess to flow through vertical pipes to the silo's lower portion. When needed, this coal discharges through a valve to the gravity-discharge elevator conveyor's lower strand.

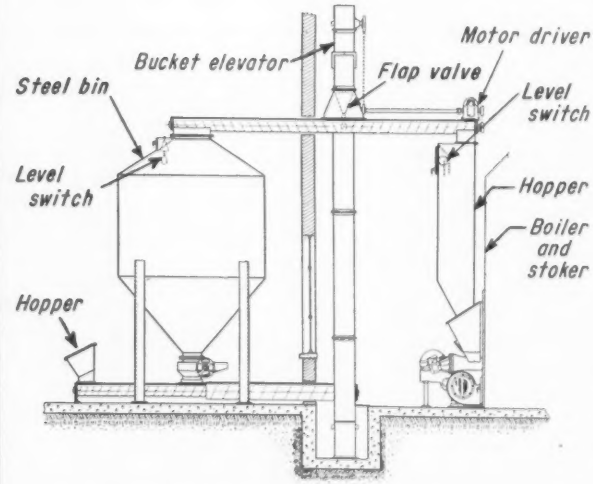
This arrangement would provide some benefits

*Condensed from a paper presented at the American Power Conference, Chicago, Ill., on March 28, 1958

These thought-provoking arrangements indicate how a new



1 **SILO IN WALL** has both live and dead storage spaces. Center outlets and heat-absorbing surface minimize frozen coal



2 **COMPLETE** small-plant system is operated by one motor. Standardization of such a system would make its cost moderate

adding to handling ease. Heated center outlets from upper and lower storage spaces would eliminate frozen coal at the silo outlets. In fact, one side of the silo would absorb heat from the boiler room and reduce coal freezing problems in general. Other advantages: (1) Fines and wet coal flow more easily and with less chance of segregation than from a side outlet. (2) Motorized coal valves would give boiler operators complete control of storage and elevating equipment. (3) Coal storage is flexible, as recovery from dead storage and delivery to any live-storage space is possible.

Now let's look at a smaller plant. Fig. 2 shows a suggested arrangement for a plant having a demand up to about one ton per hour. The scheme isn't particularly new—it's presented merely to point out that standardization of the arrangement would cut total cost to an attractive level.

A small hopper receives coal, usually delivered by truck to plants of this size. Coal moves inside the plant on a horizontal conveyor to a standard bucket elevator from which it discharges into either a storage bin or a hopper over the stoker hopper. Here is a complete coal-handling system, operated by one motor, which will also reclaim coal from the storage bin to the boiler. Further, it eliminates the boiler-aisle obstruction often posed by the conventional inclined-screw conveyor. The advantages derived from this packaged arrangement more than offset what might otherwise be a somewhat higher installed cost as compared to many systems used today.

Outdoor coal-pile utilization as active coal storage (as now employed by Public Service Electric and Gas Co of New Jersey and New York Electric and Gas Corp) can be adapted for industrial plants. Suggested arrangement, Fig. 3, has a reclaim hopper, feeder, bucket elevator and a long center scale provided for each boiler. Interconnection among coal-elevating units could be used for greater reliability. Long center scale moves coal from bucket-elevator discharge to boiler. Scales of suitable construction (which can be up to 35-ft long) can be spotted on the boiler auxiliary bay roof, thus cutting building costs.

In this arrangement a layer loader (a new device, commercially available) feeds coal without segregation to stoker hoppers. Basically, the layer loader is the equivalent of a swinging spout except that it uses only the spout's lower end. This becomes a bottomless car. This car, on wheels and having a suitable drive, travels to and fro across the top of the stoker hopper. An automatically actuated valve at the inlet feeds coal to the car. The unit gives good distribution in the stoker hopper and helps correct segregation which may be present in the incoming coal.

Layer-loader operation, Fig. 4, is as follows: View at left shows a section through the layer loader and stoker. The bottomless car is receiving coal from over-

head feed point. Automatic coal valve is open. Though the car itself has no bottom, it travels in intimate contact with the top layer of coal in the stoker hopper. This top layer actually serves as the car's bottom. Coal can't leave the car so long as the stoker is filled to car-bottom level. As coal level gradually sinks in the hopper, coal is fed from the car.

Here, the car is moving to the right, continuously putting down a fresh layer of coal over the stoker inlet. As the car moves farther to right, the automatic car-charging valve closes and car's contents are spread over stoker inlet's right half. Car reverses at stoker's end, right view, and as it again passes center point it gets another coal charge and repeats cycle for stoker's left end.

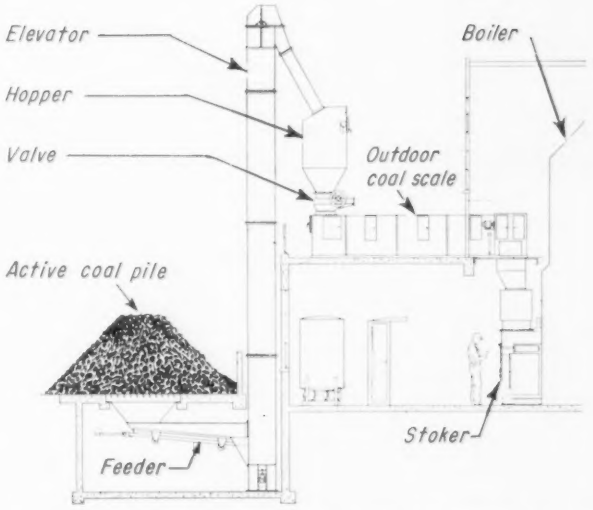
A major feature of the layer loader is its low-headroom requirement. Also, the loader could have a coal inlet at each end, leaving center section free for easy accessibility to an auxiliary gas or oil burner.

Another new stoker-feed device is part of the arrangement shown in Fig. 5. Here a belt feeder reclaims coal from an active pile and discharges into a bucket elevator. The same equipment also unloads hopper cars. A small surge hopper and scale take coal from the bucket elevator and discharge into a horizontally moving trolley-type car feeding various boilers. The car, of course, must have a discharge gate which is actuated only when car has stopped at the proper spot. Scale's operating cycle is electrically interlocked with car movement so that at each trip the car carries a precise weight of coal to a particular demand point. If desired, car can move in opposite direction to dump contents on storage pile. Note that stoker-feeder frame makes a good cantilever.

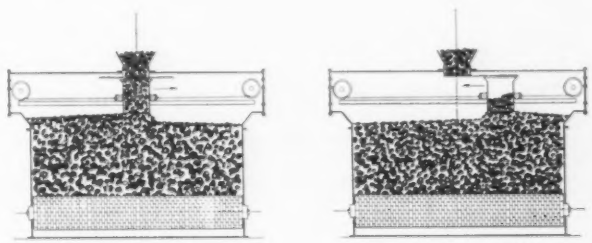
Flexibility is this arrangement's prime feature. One scale weighs all coal handled. Separate totalizers indicate coal weights delivered to each boiler, taken from each car and fed to or removed from storage. This means good control of coal receipts and utilization. Entire system is automatic and, if wanted, can be made to operate entirely outside even in cold weather.

A decade ago coal lost considerable ground to fuel oil because of availability and price fluctuations and because oil lends itself easily to automatic handling. Yet even though coal is the least-expensive fuel in many areas, oil-burning units frequently get the nod due to lower capital cost. Coal-fired unit's installed cost may be three or four times that of an oil-fired packaged boiler if all auxiliaries, instrumentation and combustion controls are included and equivalent fuel-handling convenience is provided. By equivalent fuel-handling convenience for coal-fired boilers, we mean clean and automatic coal and ash handling. We mean, too, that the entire arrangement must be as reliable as the rest of the boiler plant.

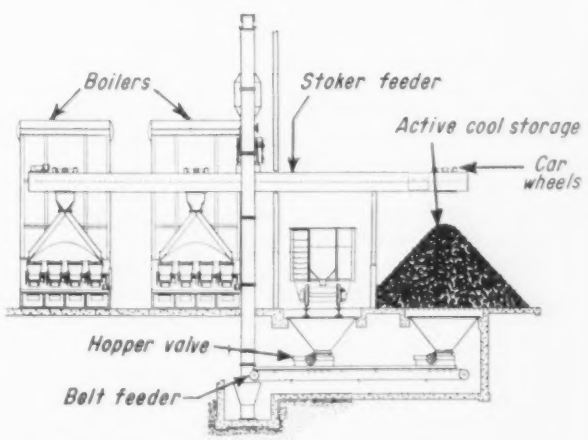
In a nutshell, much study could profitably be devoted to coal-fired boiler-plant design to pull capital costs more in line with the packaged-oil or gas-fired unit.



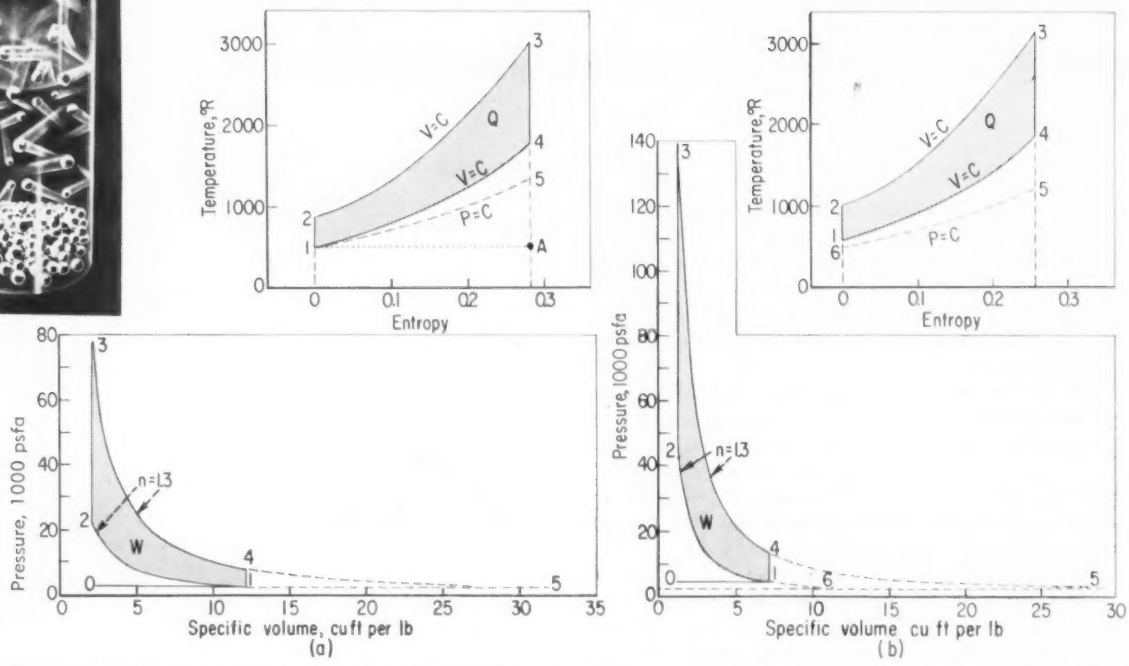
3 **OUTDOOR COAL PILE** used as active storage by some utilities could be adapted for industrial plants with this arrangement



4 **LAYER LOADER,** part of equipment in Fig. 3, is a spout converted to wheeled car, feeds nonsegregated coal to stoker



5 **FLEXIBILITY** is prime feature here. Completely automatic system weighs all coal, indicates weights fed to each boiler



1 (a) Basic Otto cycle wastes theoretical available energy measured by area *1-4-A* on T-S graph. Part that could be recovered by expansion of exhaust is *1-4-5*. (b) Supercharging Otto cycle raises peak pressure and temperature, produces more work

The search for better efficiency in our prime movers sometimes leads to unexpected results. Theoretical possibilities often seem impractical, but they may only be waiting for a bright idea. So, let's see how we could . . .

By B G A SKROTZKI
Associate Editor

Squeeze more work out of an engine

We know by now that to convert a *maximum* of heat to work, *all* the heat must enter a cycle at the highest possible temperature; also, *all* the unavailable heat must be rejected from the cycle at the lowest possible temperature.

The Otto cycle, Fig. 1*a*, can't meet these conditions because it absorbs and rejects heat at constant volume, that is, variable temperature. This makes the *average* temperature at which Q_a enters much lower than the top temperature of the cycle T_3 (see T-S graph), and the average temperature at which it rejects unused heat much higher than the lowest temperature T_1. Because of its simple, practical nature we use the Otto cycle even though it throws away a considerable amount of available energy measured by area *1-4-A-1* on the T-S graph of Fig. 1*a*.

Since $P = C$ is the atmospheric-pressure line on the T-S graph, state *A* is at a pressure much below atmospheric. There's no practical way of expanding the exhaust gas at state *4* to state *A* to salvage all the unused available energy as work. But state *5* is at atmospheric pressure, so if we can find a way to make the gas in the cylinder do work in expanding from state *4* down to atmospheric pressure at state *5* we can get the extra work output measured by the area *1-4-5-1* on both the T-S and P-V graphs.

Increasing piston stroke to V_5 is impractical. But we can pass the exhaust gas through a small turbine and make it do work like wind on a windmill. We haven't studied steady-flow processes yet, so you'll have to take our word that this can be done. This arrangement gives us a compound engine, developing main work output through the piston-driven main engine shaft, and generating a smaller

Table 1—Performance of Otto cycle without supercharging

1. Cycle specifications, see Fig. 1*a*:
   $T_1 = 500$ °R $T_3 = 3000$ °R $T_r = 3000/500 = 6.0$
   $V_r = 6.0$ $k = 1.3$ $c_v = 0.225$
   $Q_A = 482.3$ Btu per lb $R = 52.6$
   $V_1 = 12.18$ cu ft per lb $P_1 = 2160$ psfa
2. $V_2 = V_1/V_r = 12.18/6.0 = 2.03$ cu ft per lb
3. $P_2 = P_1V_1^k = 2160 \times 6^{1.3} = 2160 \times 10.28 = 22{,}200$ psfa
4. $T_2 = P_2V_2/R = 22{,}200 \times 2.03/52.6 = 856$ °R
5. $Q_A = c_v(T_3 - T_2) = 0.225(3000 - 856) = 482.3$ Btu per lb
6. $P_3 = P_2\,(T_3/T_2) = 22{,}200(3000/856) = 77{,}800$ psfa
7. $P_r = P_3/P_1 = V_rT_r = 77{,}800/2160 = 6 \times 6 = 36$
8. $P_4 = P_3(1/V_r)^k = 77{,}800(1/6)^{1.3} = 7565$ psfa
9. $T_4 = P_4V_4/R = 7565 \times 12.18/52.6 = 1752$ °R
10. $T_5 = T_3(P_5/P_3)^{\frac{k-1}{k}} = 3000(2160/77{,}800)^{0.3/1.3} = 3000(1/36)^{0.2308} = 1313$ °R
11. $Q_{45} = c_v(T_4 - T_5) = 0.225(1752 - 1313) = 98.8$ Btu per lb $= W_{45}$
12. $Q_{51} = c_v(T_5 - T_1) = 0.225\,(1752 - 500) = 281.1$ Btu per lb $= Q_R$
13. $V_5 = RT_5/P_5 = 52.6 \times 1313/2160 = 31.97$ cu ft per lb
14. $W_{15} = P_1(V_5 - V_1)/J = 2160(31.97 - 12.18)/778 = 54.95$ Btu per lb
15. $w = W_{45} - W_{15} = 98.8 - 55.0 = 43.8$ Btu per lb available for supercharging
16. $W = Q = Q_A - Q_R = 482.3 - 281.8 = 200.5$ Btu per lb
17. $w/W = 43.8/200.5 = 0.219$ or 21.9%
18. $e = Q/Q_A = 200.5/482.3 = 0.4155$ or 41.55%

Table 2—Performance of supercharged Otto cycle

1. Cycle specification, see Fig. 1*b*:
   Supercharging pressure ratio $P_1/P_6 = 2.0$
   $Q_A = 482.3$ Btu per lb (same as uncharged cycle)
   $V_r = 6$ $k = 1.3$ $c_v = 0.225$ Btu per lb
   $R = 52.6$ $P_6 = P_5 = 2160$ psfa
   $V_c = 12.18$ cu ft cylinder (same as V_1 for uncharged cycle numerically, note V_1 is specific volume of gas, but V_c is space volume in cylinder)
2. $T_1 = T_6(P_1/P_6)^{\frac{k-1}{k}} = 500 \times 2^{0.2308} = 586.8$ °R
3. $M = P_1V_c/RT_1 = (4320 \times 12.18)/(52.6 \times 586.8) = 1.705$ lb of working fluid per cycle
4. $P_2 = P_1\,(V_1/V_2)^k = 4320 \times 6^{1.3} = 44{,}400$ psfa
5. $V_1 = V_c/M = 12.18/1.705 = 7.14$ cu ft per lb
6. $V_2 = V_1/V_r = 7.14/6 = 1.19$ cu ft per lb
7. $T_2 = P_2V_2/R = 44{,}400 \times 1.19/52.6 = 1005$ °R
8. $T_3 = (Q_A + c_vT_2)/c_v = (482.3 + 0.225 \times 1005)/0.225 = 3148$ °R
9. $P_3 = P_2(T_3/T_2) = 44{,}400(3148/1005) = 139{,}000$ psfa
10. $P_4 = P_3(V_3/V_4)^k = 139{,}000(1/6)^{1.3} = 13{,}520$ psfa
11. $T_4 = P_4V_4/R = 13{,}520 \times 7.14/52.6 = 1835$ °R
12. $Q_R = Q_{41} = c_v(T_4 - T_1) = 0.225\,(1835 - 587) = 280.8$ Btu per lb
13. $Q = Q_A - Q_R = 482.3 - 280.8 = 201.5$ Btu per lb $= W$
14. $\Sigma Q = QM = 201.5 \times 1.705 = 343.6$ Btu per cycle
15. $T_r = T_3/T_1 = 3148/586.8 = 5.365$
16. $P_r = P_3/P_1 = T_rV_r = 139{,}000/4320 = 5.36 \times 6 = 32.16$
17. $T_5 = T_3(P_3/P_5)^{\frac{1-k}{k}} = 3148\,(139{,}000/2160)^{-0.2308} = 1204$°R
18. $Q_{45} = c_v(T_4 - T_5) = 0.225(1835 - 1204) = 142.0$ Btu per lb
19. $\Sigma Q_{45} = Q_{45}M = 142.0 \times 1.705 = 242.2$ Btu per cycle
20. $V_5 = RT_5/P_5 = 52.6 \times 1204/2160 = 29.3$ cu ft per lb
21. $\Sigma V_5 = MV_5 = 1.705 \times 29.3 = 50.0$ cu ft per cycle
22. $W_{56} = P_5(V_5 - V_6)/J = 2160(29.3 - 12.18)/778 = 47.6$ Btu per lb
23. $W_{61} = c_v(T_1 - T_6) = 0.225(586.8 - 500) = 19.5$ Btu per lb
24. $w = W_{45} - W_{56} - W_{61} = 142.0 - 47.6 - 19.5 = 74.9$ Btu per lb
25. $\Sigma w = Mw = 1.705 \times 74.9 = 127.7$ Btu per cycle
26. $\Sigma w/\Sigma Q = 127.7/343.6 = 0.372$ or 37.2%
27. $\Sigma Q/Q_1 = 343.6/200.5 = 1.713$ or 71.3% more work output available at turbine shaft than *unsupercharged* cycle
28. $e = Q/Q_A = 201.5/482.3 = 0.4175$ or 41.75%

"byproduct" work output through the turbine shaft.

There's one catch to this setup—it's not practical to couple the shafts together to drive a common load because the turbine usually turns much faster than the main engine shaft. Also, we seldom find two loads in the right proportion that vary in step so they can use the main engine and turbine outputs individually. So how can we use the turbine power?

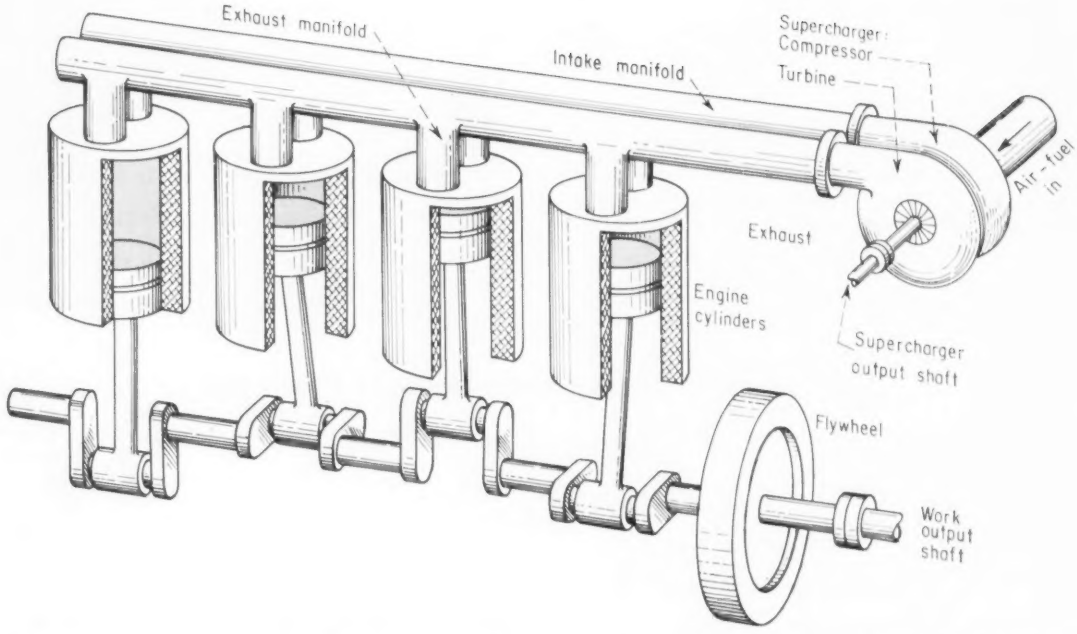
Supercharging. The extra work developed by the exhaust turbine makes it possible to increase the total work produced in the engine cylinder. Fig. 2 shows a 4-cylinder Otto engine using a supercharger which consists of an exhaust turbine driving a centrifugal compressor.

The four cylinders are displaced in timing by a quarter cycle, so the crankshaft gets a power stroke every half revolution. The four cylinders discharge a pulsating flow of exhaust gas into the exhaust manifold which acts as a receiver to damp pressure pulsations. This smooths out the flow of gas to a steady stream through the turbine so it generates a steady shaft-work output.

The turbine shaft drives the centrifugal compressor which inhales a steady flow of air and pressurizes it to double atmospheric or more. The pressurized intake air enters the intake manifold from which the cylinders draw their air in turn.

Let's see just what this supercharging device does. Fig. 1*a* shows the performance of an Otto cycle working with a compression ratio of 6.0; Table 1 gives the computations for this cycle. Fig. 1*b* shows the performance of the same engine fitted with a supercharger that pressurizes the cylinder intake air to double atmospheric at state *1*. Table 2 gives the calculations for the supercharged engine and assumes that the same heat *per lb of air* is added to the cycle as in the unsupercharged engine in Fig. 1*a*.

In Table 1 we figure the additional work that can be generated by an exhaust turbine shown as area *1-4-5* in Fig. 1*a*. Item 11 figures the gross work generated by expanding the exhaust to atmospheric pressure at constant S, from state *4* to *5*. But, remember, in the equivalent closed cycle the gas must be returned to its original starting state. So, after ex-



2 Four-cylinder Otto engine has individual cycles phased so crankshaft gets power stroke every half revolution. Exhaust flows through turbine that generates shaft work to drive centrifugal compressor that pressurizes air input to the engine cylinders

panding to P_6 (atmospheric), the gas must be cooled back to state *1* at constant pressure. To do this we must do work on the gas during the constant-pressure cooling from V_5 to V_1 in compressing it to the smaller volume. This is figured in Item 14.

Item 15 gives the net work w that could be generated by an exhaust turbine. For the conditions specified this equals 21.9% of the net work W generated by the main engine as shown in Item 17.

When we apply this byproduct power output in a supercharger we find the states of the working fluid completely changed throughout the cycle as in Fig. 1*b*, and Table 2. The cycle really starts at state *6* where the air enters the centrifugal compressor at atmospheric conditions, the same as in Fig. 1*a*. The compressor delivers the air at state *1* into the cylinder at just double atmospheric pressure, that is, $P_1/P_6 = 2$. We assume *6-1* is a constant-S compression.

Since we are using the same engine as in Fig. 1*a*, the cylinder has the same volume. But at higher pressure it can hold a greater mass of air because the air has a smaller specific volume. Item 3 in Table 2 figures the mass in lb per cycle. Note that it's not double, even though the pressure is double, because the constant-S compression raises the temperature of the air forced into the cylinder.

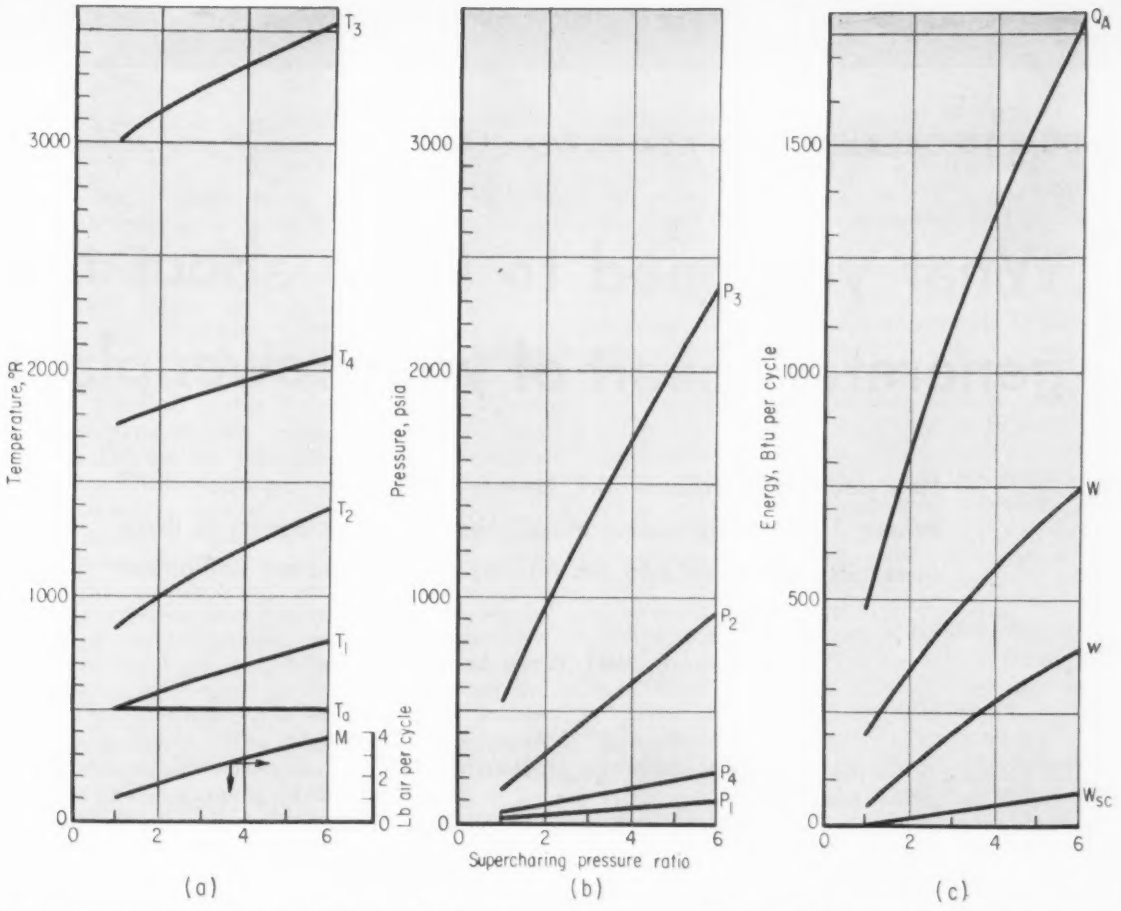
Throughout the supercharged cycle we find that pressures and temperatures are higher and the specific volumes smaller. Primarily because of the greater mass of air passing through the engine we find it produces a greater work output per cycle as shown in Item 14, Table 2, compared to Item 16, Table 1. There is a slight gain in W per lb (201.5 Btu vs 200.5 Btu) because of the higher average temperature at which heat Q_A enters the cycle; this makes the supercharged cycle slightly more efficient—compare Item 18, Table 1 with Item 28, Table 2.

Studying the T-S graph of Fig 1*b* we find that the net work output that could be produced by the supercharger (beyond what is used by the compressor) is measured by area *6-1-4-5*. This is considerably larger than that produced by the turbine in the unsupercharged engine in Fig. 1*a*, measured by area *1-4-5*.

Item 26, Table 2 shows that the supercharger can produce byproduct power equal to 37.2% of the work produced per cycle. Compared to the unsupercharged engine it produces 71.3% more work, Item 27. So we find that supercharging not only increases the work output per cycle of an engine but also the amount of byproduct work it could produce in the exhaust turbine.

Fig. 3 summarizes the changes in Otto-cycle states, as numbered in Fig. 1, for supercharging pressure ratios ranging from 1.0 to 6.0. This assumes, as in Tables 1 and 2, that the heat input *per lb of air* stays constant. Fig. 3*a* shows moderate changes in temperature with increasing supercharging. Top temperature of the cycle, T_3, rises by 532 F over the base cycle (supercharging ratio = 1), less than 18% of the base 3000 °R. But, since T_1 also rises with supercharging ratio, we find this works out to only a minor rise in cycle thermal efficiency, from 41.6 to 42.3% over the range shown.

Highly supercharged engine cylinders and pistons would have to be made of metals that could withstand the higher intermittent top temperatures—this would not be too knotty a problem. But the rise in working



3 (a) Supercharging pressure ratio rise causes all cycle temperatures to rise moderately. Biggest change is in lb of air passing through cylinder. (b) Pressures rise sharply with supercharging. (c) Supercharging boosts heat input and work output

fluid, to 3.7 lb per cycle at the supercharging ratio of 6, proves to be the key to increased work output per cylinder or per cycle—the basic advantage of supercharging.

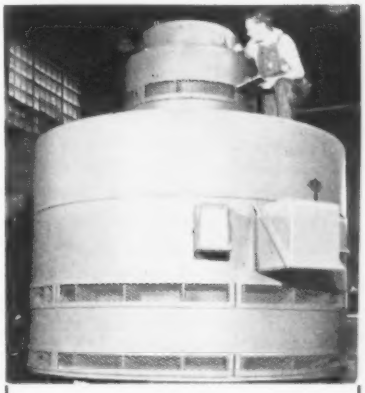
Fig. 3*b* shows a tremendous rise in top pressure, P_3, with supercharging, about 4.3 times the base cycle at a supercharging ratio of 6. This means we would have to build the cylinder wall much heavier and use generally heavier construction with supercharging, but the engine size would be about the same. The rise in exhaust pressure P_4 contributes to the rise in byproduct power of an exhaust turbine working with a supercharged engine, but more lb air per cycle is the controlling factor.

Fig. 3*c* shows the tremendous rise in heat added per cycle Q_A caused by the greater amount of working fluid passing through the cylinder of fixed dimensions and compression ratio. This causes a corresponding rise of 370% in main work output W. Concurrently, we have a rise in byproduct work w that could be generated by an exhaust turbine. This jumps from 21.5% of W for the base cycle to 51% for the supercharging ratio of 6.

Despite this great rise in availability of byproduct power, the work of supercharging needed by the compressor W_{sc} is only 9.3% of the main work W or 18% of the byproduct work w at the supercharging ratio of 6. The supercharger uses only a small part of the work that could be developed by the turbine.

This waste of available energy by supercharged cycles has led to the development of the free-piston compressor and the free-piston gas generator which we'll discuss later in the series.

Next part covers engine throttling and actual engine performance—in a forthcoming issue.



Correction

POWER's story on the Memphis plant, March 1958, pp 100-101, misidentified the circulator motors. These six 1250-hp 327-rpm 4160-v synchronous motors were built by Electric Machinery Mfg Co.

HOW TO ORGANIZE YOUR NEW POWER PLANT—33

What you need to know about the generator—heart of your power plant

How does a generator work? How is it cooled during operation? Where is hydrogen cooling used? Here are the answers to these questions, plus basic info on this key piece of power equipment

By DONALD SWIFT, Ebasco Services Incorporated

The generator is the most important piece of equipment in an electric power plant. It produces the plant's end product—electricity. All other equipment is there only because it is necessary, in one way or another, to generator operation.

Generators can take an almost infinite number of forms. There are many possible arrangements for accomplishing the basic requirements for electric generation (i.e., one or more closed loops of wire cutting through a magnetic field, resulting in production of an electric current).

Modern generators commonly are horizontal machines with rotating field and stationary armature coils. Alternating current is produced at any value from 110 to 20,000 volts or higher. Alternation frequency is usually 60 cps in the U.S. and 50 cps in Europe. Some special applications, such as railroads, use 25 cps; some mills use frequencies as high as 300 cps for driving special process machines. A few direct current units also are built. Nearly all alternating current generators produce 3-phase current. Voltages and currents in the three windings are 120 electric degrees out of phase with each other.

From the standpoint of steam turbine efficiency, it is advantageous to run at 5000 to 10,000 rpm. But generators are more easily built to run at 600 to 1800 rpm. Gear sets can be used to reduce a high turbine speed to a desirable generator speed, but their cost and space requirements are generally greater than their advantages. Ordinarily, a turbine is run at a compromise speed of 1800 to 3600 rpm with direct coupling to generator.

Generator field. The magnetic field for an alternating-current generator is created by passing direct current through a wire coil. This requires a source of direct current, which is ordinarily an exciter. The coil is on a laminated iron core or pole so the magnetizing current produces maximum magnetic flux. A complete magnetic path must be supplied for the magnetic lines of force and therefore the generator stator core also is made of laminated iron sheets. Armature coils are set in slots formed on the inside circumference of the core. The air gap between field and armature is made as small as possible, consistent with required mechanical clearances. This gives minimum reluctance for the magnetic path.

As a direct current passes through the field coils, the magnetic lines of force (1) concentrate inside the field coil and its supporting poles (2) pass through the air gap into the stator core (3) spread out into multiple paths of least resistance to pass around the stator into the neighborhood of the nearest adjacent magnetic pole of opposite polarity (4) pass across the air gap again and (5) enter the opposite end of the first field pole to complete the magnetic circuit. If the field is at rest, this magnetic circuit is at rest also, and no voltage is generated in stator coils.

However, when the field is revolved, the lines of magnetic force entering and leaving the stator near the field poles revolve also. They are cut by the stationary armature windings which are set at right angles to the magnetic flux movement. This generates a voltage in the armature coils and, if a closed circuit is provided, current flows. The voltage generated depends on the number of magnetic lines cut in a given interval of time.

So for a given machine generated voltage depends on machine speed and strength of the magnetic field. This latter, in turn, is determined by the amperes of

field current applied and by the conductance of the various parts of the magnetic circuit.

Generator speed. As one pole of the field passes a given set of coils, the voltage generated builds up to a maximum, recedes, and then builds up to a maximum in the opposite direction as the adjacent field pole, with lines of magnetic force flowing in the opposite direction, passes by the coils. One cycle or voltage alternation is made each time a pair of field poles passes a given set of coils. With a 2-pole field running at 3600 rpm or 60 rps, there are 60 alternations or 60 cycles per second. If the field has four poles, there are two alternations for each revolution, and the machine must run at 1800 rpm or 30 rps for 60-cycle power generation.

From an electrical design point, slower speed is advantageous because with more poles closer together a shorter magnetic path can be used. Then too, centrifugal forces on field coils, exciter coils and commutator are considerably lower, making their design much simpler. On the other hand, a higher speed permits making the generators somewhat smaller, turbine size is reduced and efficiency is increased. Most modern turbine-generators run at 3600 rpm, except for some large units where exhaust area is a limiting factor.

Generator cooling. Generating electricity produces heat. The I^2R losses in field and armature coils, heat created in the stator laminations because of rapid alternation of magnetism, windage, friction and heat from bearings, add up. Generator losses vary from 1 to 5% or more of rated output. These losses show up in the form of heat that must be dissipated to avoid excessive temperature rise in the generator, with resultant harm to generator insulation.

All early generators and many present-day units in the smaller sizes are cooled by air circulation. If open or once-through cooling is used, dirt may accumulate on the windings. This interferes with heat transfer and adversely affects the insulation. Filters using replaceable or cleanable elements help keep the windings clean. Spray washers provided with water-removing baffles are also used to clean and cool the air. These methods require considerable operating attention and maintenance.

An alternative method uses a closed cooling system. Air is constantly recirculated and cooled by passing it over finned cooler tubes. Dirt is thus kept out of the system, and if low-temperature cooling water is available, summer air temperatures are lower than they would be in a straight air-cooling system.

Hydrogen cooling. Most of the larger modern generators use hydrogen gas instead of air in the closed generator cooling circuit. Hydrogen weighs only about 1/16 as much as air, yet it has quite a high thermal capacity. Using it reduces windage losses, improves heat removal and transfer to coolers.

A mixture of hydrogen and oxygen is explosive when oxygen is 20 to 85% of the total mixture. Precautions must be taken to avoid trouble. For example: (1) Special oil seals are used on the shaft at each end of the generator. (2) Pressure is maintained in the generator housing to prevent air from leaking in. (3) When the generator is being filled, the air is first purged with carbon dioxide gas, then this is removed as the hydrogen is added. This avoids contact between hydrogen and air. Similarly, in emptying a hydrogen-filled generator, the hydrogen is first forced out with CO_2. Then air is allowed to enter.

In operation, hydrogen purity must be held up to about 90%. If seal oil is contaminated by air, hydrogen quality gradually deteriorates. Some hydrogen is lost by absorption in the oil and through system leaks. As a rule, the hydrogen required to maintain the pressure in the system is also sufficient to maintain the necessary purity. Occasionally some unusual condition may require bleeding the system and adding fresh gas to improve the purity.

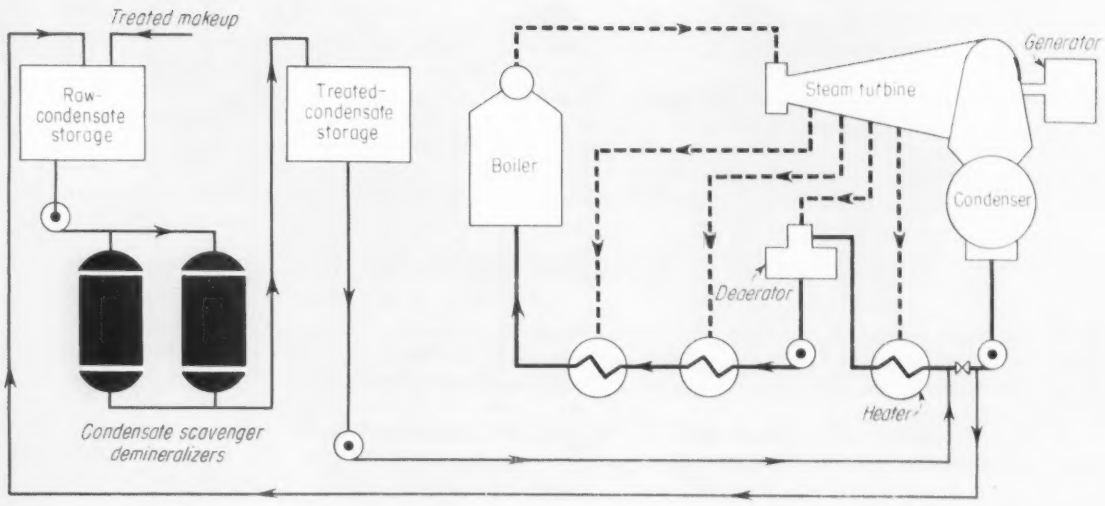
Hydrogen pressures used in generator cooling systems may vary from 0.5 to as much as 60 psig, depending on system design. Cooling ability improves as the pressure is raised and the gas becomes more dense. The generator casing and all parts exposed to the hydrogen must be strong enough to withstand the design pressure. Seal oil pressure is usually 5 to 10 psi above gas pressure to prevent leakage. Leakoff chambers, between the seal proper and the outer labyrinth seal, are intended to collect oil that leaks out of the seals. Leakage oil from the hydrogen side must be trapped or run through a seal loop to prevent hydrogen loss.

Fans on the end of the generator rotor circulate the hydrogen gas. It is passed over two or more coolers and forced past the generator windings. In the latest models, field coils are arranged to permit forced gas passage around or through them. This provides a maximum amount of heat transfer for a given hydrogen temperature.

Stator coils are also more effectively cooled by forcing hydrogen through them directly in contact with the bare copper. Another advanced method pumps a noncorrosive, nonconducting cooling fluid through hollow tubular conductors that are grouped together and insulated to form a generator stator coil. These methods increase generator capacity three or four fold for a given frame size.

If the generator is very large, several coolers may be used. They are usually arranged so they can be taken out of service one at a time for cleaning, without generator shutdown. However, load may have to be reduced somewhat.

Generator temperatures. Temperature-indicating resistance coils or thermocouples indicate (1) gas temperatures to and from the generator (2) temperature of a number of armature coils at representative points throughout the generator. These temperatures are usually indicated (*Continued on page* 182)



DEMINERALIZERS remove dissolved-solids in condensate. Filters are often used before and after. Storage tanks are optional

Condensate demineralizers combat

Supercritical-pressure boilers are pioneering condensate demineralizing. Now, potential heat-rate gain also points to widespread future use for subcritical-pressure boilers

By S B APPLEBAUM, Director, Water Treatment Div Cochrane Corporation

Condensate scavenger demineralizers are one of today's newest water-treatment tools. Supercritical power plants at American Gas and Electric Company, Philo, Ohio, Cleveland Electric Illuminating Company, Avon, Ohio and Philadelphia Electric Company, Eddystone, Pa. will all demineralize their condensate.

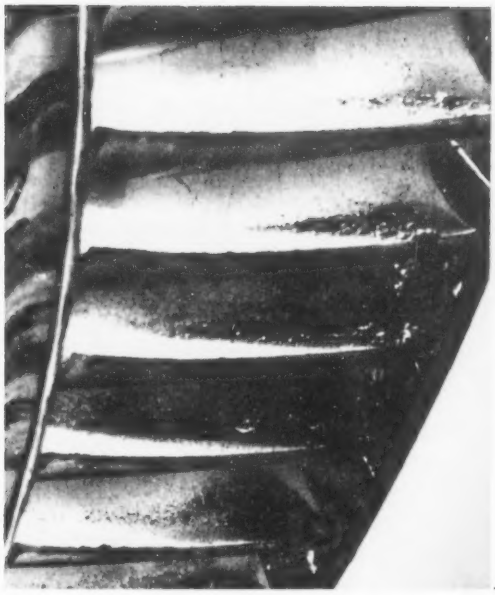
Demineralizers at these plants can reduce total feedwater dissolved solids below 0.04 ppm (10 million ohms/cm resistivity). Silica will be below 0.01 ppm. This top-quality feedwater is essential for supercritical once-through drumless boilers. Since water enters the boiler tubes at one end and steam leaves at the other, any dissolved solids present will crystallize out. These deposit on boiler tubes or carry over with the steam and leave troublesome deposits in superheater or turbine.

But what about condensate demineralizers for subcritical boiler installations where pressure is 1800 to 2400 psig? J Angelo and K C Cotton recently made a survey of eight power plants in this range. They studied effects of turbine deposits on efficiency and plant heat rate. Box, facing page, summarizes some of their conclusions on the cost of deposits.

Efficiency of plants operating at 1450 psig is not adversely affected by the type of turbine deposits investigated. But, at higher pressures, changes in water treatment or boiler chemistry are needed to realize the better efficiency expected from increased investment for higher-pressure boilers and turbines. Angelo and Cotton estimate value of 1.0% heat-rate loss at about $20 million per year based on total power generation for 1956. This emphasizes the importance of re-evaluating water-treatment methods for subcritical high-pressure boiler installations.

What changes are needed in water-treatment methods? To help understand the significance of needed changes, and put them in proper perspective, let's briefly retrace water-conditioning progress.

Go back about 40 years. Boiler pressures are about 250 psig and simple external-makeup treatment is adequate. First hot-process lime-soda plants and later cold-process salt-re-



How much do turbine deposits cost?

Photo, left, shows heavy deposits under turbine bucket covers. In ASME paper *57-A-116*, J Angelo and K C Cotton report turbine-efficiency losses from deposits at eight plants. There is little drop in efficiency at 1450 psig. But at initial pressures of 1800 to 2400 psig there's a 3% loss in the high-pressure section and a 1.5% loss in the intermediate-pressure section. Result is a 1% loss in overall heat rate worth about $34,000 per year on a 200,000-kw machine with 80% load factor and 30-cent fuel. Angelo and Cotton further estimate deposit-free turbine operation would be worth $20 million a year to the utility industry. This is based on 600-billion kwhr generated in 1956 and 1% heat-rate loss. It looks like about half the 1.8% heat-rate gain for increasing initial pressure from 1450 to 1800 psig may be lost to steam-path deposits.

deposits for potential 1% heat-rate gain

generated ion exchangers soften the makeup. Often with low-hardness waters it's possible to treat boiler water internally using chemicals alone. The boiler itself serves as a water-treatment vessel where chemicals are added. Hardness is precipitated as a less-adherent sludge and discharged to waste through boiler blowoff.

Boiler pressures gradually increase to 500 to 700 psig with a subsequent decrease in boiler-drum size. More elaborate external treatment is necessary and makeup water has to be clarified and softened outside the boiler. Two-stage hot lime soda—hot phosphate comes into the picture about 1938. Still later styrene-base cation resins are produced capable of withstanding high temperature and pH. Hot-lime treatment is then combined with hot zeolite. Now the Standard Oil Company, Whiting, Ind., uses this method to successfully treat 100% makeup for boilers operating as high as 1500 psig.

In about 1935, in the field of ion exchange, new materials are first introduced that permit acid regeneration of ion exchangers for alkalinity as well as total hardness reduction.

To prevent carryover and keep the steam pure, it's necessary to chemically remove oil or other saponifiable matter, keep ratio of alkalinity to total solids below about 1 to 4 and in general reduce total dissolved solids. Continuous boiler blowoff is introduced to give better control of boiler-water concentration and recover heat in the blowoff stream. Mechanical steam separators and washers located outside or inside boiler drums are found helpful.

Even though external water treatment makes rapid progress, internal-treatment chemicals are needed. Residual hardness, oxygen and other impurities are still present in small amounts in externally treated makeup. And condenser and pump-gland leakage often brings impurities into the condensate. Internal boiler-water treatment techniques are used to keep needed amounts of phosphate, sulphite, etc in the boiler to handle leakage.

Chemical compounds are developed to disperse sludge and avoid hideout and boiler-tube deposits. Chemicals help prevent boiler foaming.

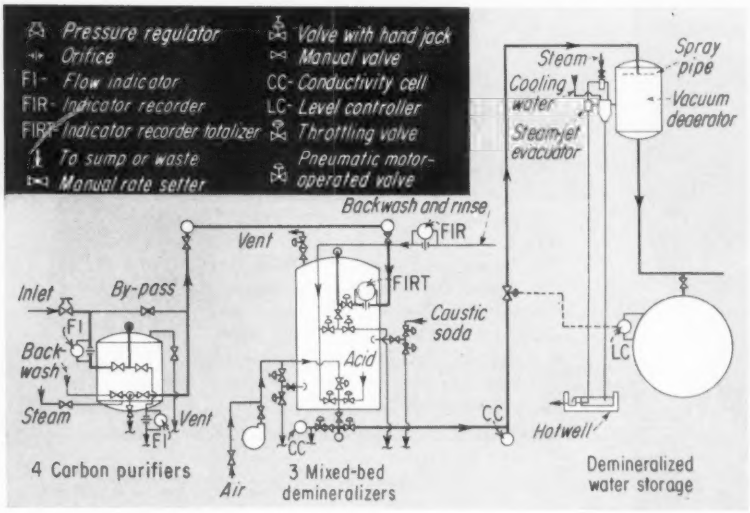
As boiler pressures again advance to the range of 1200 to 1500 psig and later to 1800 to 3250 psig, silica becomes Enemy No. One. It's harmful not only in boilers, but in the turbines. Ion-exchange demineralizers then make their entrance to remove practically all dissolved solids and silica in the makeup water. First multibed and later mixed or monobed demineralizers are perfected. These units in various combinations now vie successfully with evaporators for complete makeup-water treatment. At this point, condensate scavenger demineralizers are adopted for supercritical boilers.

From this brief history, it's apparent that present water-treatment practice has two main bases:

(1.) Supplementary chemical treatment is expected to take care of any leaks or impurities that enter with treated makeup. So the external water-treating plant can have appreciable leakage tolerance taken care of by later internal treatment in the boiler. This keeps first cost and chemical-operating cost at a minimum.

(2.) Condensate from condensers is assumed pure and so doesn't need

These mixed-bed units have operated on condensate for about three years.



Mixed-bed demineralizers, left, are treating condensate and small amounts of makeup at AEC facilities, Oak Ridge, Tenn. Plant capacity is 800 gpm or 400,000 lb/hr. After treatment the condensate contains less than 0.04-ppm dissolved solids. It's interesting that there hasn't been any fouling of ion-exchange resins after almost three years of operation. Probable main reason is that any organics present are destroyed in the boiler evaporation cycle. Pretreatment with activated-carbon purifiers gives added insurance against organic fouling, particularly when makeup is introduced. Since resin fouling is a headache with demineralizers, its absence is encouraging.

Solids added to feedwater by condenser leakage

Condenser leakage, %	Water leakage lb/hr	Solids added to feedwater per hr	per year
0.005	50	0.015	131
0.025	250	0.075	655
0.050	500	0.150	1310
0.500	5000	1.500	13100

Based on one million lb/hr condensate flow with 300-ppm total solids in condenser cooling water

any additional external treatment.

But these two considerations are no longer enough. There are four areas in which present practice should be changed as soon as possible:

(1) Tighten up leakage tolerance from the external makeup-water treatment plant. This means even lower silica and total dissolved solids. One way to do this is to design the equipment even more conservatively. For example, supplement two- or three-bed demineralizing plants with mixed-bed units for polishing or finishing service. Treated makeup then contains less than 0.04-ppm dissolved solids and 0.01-ppm silica. Fewer solids will enter the boiler and danger of boiler, superheater and turbine deposits is greatly reduced.

(2) Use deaerators of more conservative design and place less reliance on surface condenser deaeration.

(3) Use vapor-type chemicals rather than solid-type for supplementary internal treatment. Angelo and Cotton define solid-type chemicals as those which make salts when they react with the impurity. And these salts are capable of forming deposits in turbines. This is one of the main reasons why Public Service Electric and Gas Company of New Jersey has switched to hydrazine and ammonia.

(4) Treat condensate externally with scavenger equipment to insure deposit-free boiler and turbine operation. As the table shows, even a very small amount of condenser leakage brings large amounts of solids into the boiler cycle. It's true that condensate scavenger equipment has to be much larger than makeup-treatment plants which handle only 1% of feedwater. But quantity of solids present in untreated condensate is usually under 0.5 ppm compared to 50 to 200 ppm in untreated makeup. Reducing 0.5 ppm to 0.05 ppm is 90% removal and will go a long way in avoiding the turbine deposits reported by Angelo and Cotton.

Mixed-bed demineralizers can do a good job of condensate scavenging. Box, above, outlines equipment used to treat condensate and small amounts of makeup at the AEC facilities, Oak Ridge, Tenn. Organic fouling of the anion resin isn't a problem, even after three years of operation.

Small amounts of solids removed mean long runs between regeneration. Labor is kept to a minimum and regenerate cost is almost negligible.

But problem remains of relatively high first cost for demineralizing equipment if it's sized to handle 100% of the total feedwater stream. One point in its favor is that makeup treatment can be simplified using two-bed systems without polishing to

(Continued on page 198)

Power's data sheet

Alloy-steel pipe to ASTM Spec A-335 Grade P-12 (1 Cr½ Mo)

Pipe Size In.	Nom. OD In.	Wall Thick In.	Temperature — F: To 750	800	850	900	950	1000
			Maximum allowable stress — PSI: 15,000	14,750	14,200	13,100	11,000	7500
Schedule 10								
14	14	.250	330	324	312	288	245	168
16	16	.250	291	286	270	254	214	146
18	18	.250	255	251	241	223	190	130
20	20	.250	233	229	220	203	171	117
24	24	.250	195	191	184	170	143	97
Schedule 20								
8	8.625	.250	540	531	511	471	400	274
10	10.75	.250	435	427	411	380	319	219
12	12.75	.250	366	360	346	320	269	184
14	14	.312	450	442	426	393	332	228
16	16	.312	390	383	369	341	290	199
18	18	.312	345	339	326	301	257	176
20	20	.375	399	397	383	353	293	202
24	24	.375	330	324	312	288	244	167
Schedule 30								
8	8.625	.277	630	620	596	550	462	317
10	10.75	.307	578	568	547	504	425	292
12	12.75	.330	534	525	511	471	393	270
14	14	.375	570	560	540	498	421	289
16	16	.375	495	486	469	432	368	252
18	18	.438	540	531	511	471	394	270
20	20	.500	570	560	540	498	418	288
24	24	.562	540	531	511	471	399	274
Schedule 40								
½	.84	.109	1695	1667	1605	1480	1256	876
¾	1.05	.113	1455	1430	1377	1271	1074	747
1	1.315	.133	1569	1543	1485	1375	1163	810
1¼	1.66	.14	1059	1041	1008	930	781	541
1½	1.90	.145	1005	988	951	877	742	513
2	2.375	.154	906	891	858	786	668	461
2½	2.875	.203	1215	1195	1150	1061	899	623
3	3.50	.216	1095	1077	1036	956	808	559
4	4.50	.237	975	959	923	851	717	496
5	5.563	.258	885	870	838	773	656	453
6	6.625	.28	833	819	788	727	614	423
8	8.625	.322	771	758	730	668	568	392
10	10.75	.365	720	708	681	628	533	367
12	12.75	.406	690	679	653	603	512	352
14	14	.438	690	679	653	603	509	351
16	16	.50	713	701	675	622	525	361
18	18	.562	726	714	687	634	535	368
20	20	.593	690	679	653	603	511	351
24	24	.687	683	671	646	596	503	346
Schedule 60								
8	8.625	.406	1035	1017	980	904	765	529
10	10.75	.50	1071	1053	1014	930	791	547
12	12.75	.562	1035	1017	980	904	762	527
14	14	.593	999	982	946	877	737	510
16	16	.656	975	959	923	851	723	500
18	18	.750	1011	994	957	883	746	516
20	20	.812	990	973	937	864	733	507
24	24	.968	1005	988	951	877	774	535
Schedule 80								
½	.84	.147	3036	2985	2874	2646	2272	1616
¾	1.05	.154	2589	2551	2456	2266	1932	1365
1	1.315	.179	2612	2568	2472	2281	1949	1378
1¼	1.66	.191	1935	1902	1831	1690	1441	1009
1½	1.90	.20	1821	1791	1724	1585	1352	945
2	2.375	.218	1665	1638	1576	1454	1232	860
2½	2.875	.276	1943	1910	1839	1696	1443	1011
3	3.50	.30	1770	1740	1675	1545	1312	917
4	4.50	.377	1599	1572	1514	1396	1185	826
5	5.563	.375	1470	1445	1391	1283	1092	760
6	6.625	.432	1470	1445	1391	1283	1091	759
8	8.625	.50	1344	1322	1272	1174	995	691
10	10.75	.593	1311	1289	1241	1140	970	673
12	12.75	.687	1305	1283	1235	1140	965	670
14	14	.75	1311	1289	1241	1140	970	673
16	16	.843	1305	1283	1235	1140	967	671
18	18	.937	1305	1283	1235	1140	963	668
20	20	1.031	1299	1277	1235	1134	961	667
24	24	1.218	1290	1269	1221	1127	958	664

Pipe Size In.	Nom. OD In.	Wall Thick In.	Temperature — F: To 750	800	850	900	950	1000
			Maximum allowable stress — PSI: 15,000	14,750	14,200	13,100	11,000	7500
Schedule 100								
8	8.625	.593	1650	1622	1562	1441	1222	852
10	10.75	.718	1635	1608	1548	1428	1216	848
12	12.75	.843	1650	1622	1562	1441	1226	855
14	14	.937	1695	1666	1605	1480	1254	875
16	16	1.031	1635	1608	1548	1428	1214	847
18	18	1.156	1650	1622	1562	1441	1221	852
20	20	1.281	1650	1622	1562	1441	1227	856
24	24	1.531	1665	1638	1576	1454	1235	861
XX								
½	.84	.294	9222	9068	8730	8054	7206	5654
¾	1.05	.308	7532	7406	7130	6578	5815	4434
1	1.315	.358	7140	7021	6759	6236	5498	4165
1¼	1.66	.382	5580	5487	5282	4873	4250	3140
1½	1.90	.400	5115	5030	4842	4467	3883	2849
2	2.375	.436	4485	4410	4246	3917	3390	2463
2½	2.875	.552	4935	4853	4672	4310	3742	2738
3	3.50	.600	4410	4337	4175	3851	3332	2418
4	4.50	.674	3855	3791	3649	3367	2902	2088
5	5.563	.750	3480	3422	3294	3039	2613	1870
6	6.625	.864	3420	3363	3238	2987	2566	1836
8	8.625	.875	2609	2565	2469	2278	1947	1376
Schedule 120								
4	4.50	.438	2235	2198	2115	1951	1667	1172
5	5.563	.50	2130	2094	2016	1860	1581	1110
6	6.625	.562	2040	2006	1931	1781	1515	1063
8	8.625	.718	2070	2035	1960	1808	1536	1077
10	10.75	.843	1980	1947	1874	1729	1469	1029
12	12.75	1.00	2010	1977	1902	1755	1493	1046
14	14	1.093	2010	1977	1902	1755	1495	1048
16	16	1.218	1980	1947	1874	1729	1468	1028
18	18	1.375	1995	1962	1889	1742	1485	1041
20	20	1.50	1965	1931	1860	1716	1462	1024
24	24	1.812	2003	1969	1896	1749	1488	1043
Schedule 140								
8	8.625	.812	2385	2345	2257	2083	1778	1253
10	10.75	1.00	2406	2366	2278	2096	1793	1264
12	12.75	1.125	2295	2257	2172	2004	1709	1203
14	14	1.25	2340	2301	2215	2043	1745	1229
16	16	1.437	2376	2336	2249	2070	1770	1247
18	18	1.562	2310	2271	2187	2017	1716	1208
20	20	1.75	2340	2301	2215	2043	1740	1225
24	24	2.062	2310	2271	2187	2017	1718	1209
Schedule 160								
½	.84	.187	4545	4469	4302	3969	3441	2502
¾	1.05	.218	4500	4425	4260	3930	3404	2474
1	1.315	.25	4296	4224	4067	3752	3243	2350
1¼	1.66	.25	3006	2956	2846	2620	2249	1599
1½	1.90	.281	3090	3039	2925	2698	2317	1649
2	2.375	.343	3225	3171	3053	2816	2417	1724
2½	2.875	.375	2961	2912	2803	2586	2215	1574
3	3.50	.438	2930	2881	2773	2558	2191	1556
4	4.50	.531	2871	2823	2718		2146	1523
5	5.563	.625	2790	2743	2641	2436	2087	1479
6	6.625	.718	2730	2684	2584	2384	2043	1446
8	8.625	.906	2715	2669	2570	2371	2028	1435
10	10.75	1.125	2753	2707	2606	2404	2056	1456
12	12.75	1.312	2730	2684	2584	2384	2043	1446
14	14	1.406	2670	2625	2527	2332	1997	1413
16	16	1.593	2670	2625	2527	2332	1992	1409
18	18	1.781	2670	2625	2527	2332	1990	1408
20	20	1.968	2663	2618	2521	2325	1988	1406
24	24	2.343	2655	2610	2513	2318	1983	1403

Maximum allowable working pressures—4

Figures in table give maximum psi pressures for given temperatures and stresses. See February *Data Sheet* 306 for basic formula from which table was calculated.

GEORGE C HALZELL, *Boston, Mass.*

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Why You Get HIGHER EFFICIENCY in a RILEY TURBO FURNACE

The Riley Turbo Furnace, a new concept in furnace design, has created unusual interest in the power industry. Already, in only a few short years since its introduction, twenty-three Turbo Furnace units with a total steam capacity of 14,000,000 lbs/hr have been bought by public utilities and industrial companies. Sizes range from 125,000 lbs/hr to reheat units of 1,650,000 lbs/hr and are being installed for the most part as multifuel units to burn oil, gas and coal. Three units are already successfully burning the newest of petroleum by-products fuels: Fluid Coke.

One of the most attractive features of the Turbo Furnace is its high furnace efficiency. Firing of fuels at the bottom of the circulation system makes possible full utilization of furnace waterwall surfaces from top to bottom and permits higher heat release per square foot of furnace envelope. Vertical displacement of furnace gases results in clean, slag-free furnace surfaces and a uniform distribution of furnace heat across the entire width and depth of the furnace.

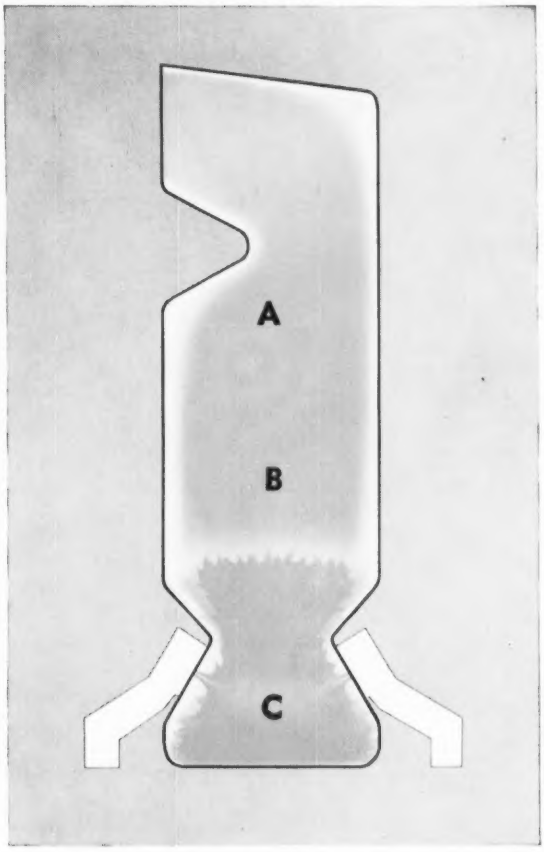


Fig. 1. Flame and Furnace Gas Characteristics of the Riley TURBO FURNACE

High Furnace Turbulence
High Burn Out Rate

As can be seen in the furnace cross section, Figure 1, air and fuels enter the combustion zone of the Turbo Furnace in a downward linear direction from Riley Intertube Directional Flame Burners arranged for opposed firing across the width of the furnace. The opposed streams of fuel and air intermix in the center of the furnace (over the slag pool when pulverized coal is burned) to produce a highly, turbulent area of combustion which fills all the area below the furnace throat. Long residence time of fuels in the area results in a negligible loss of combustibles.

A survey of your plant by a qualified consulting engineer could show ways of making surprising savings in your power costs.

RILEY
STEAM GENERATING & FUEL BURNING EQUIPMENT

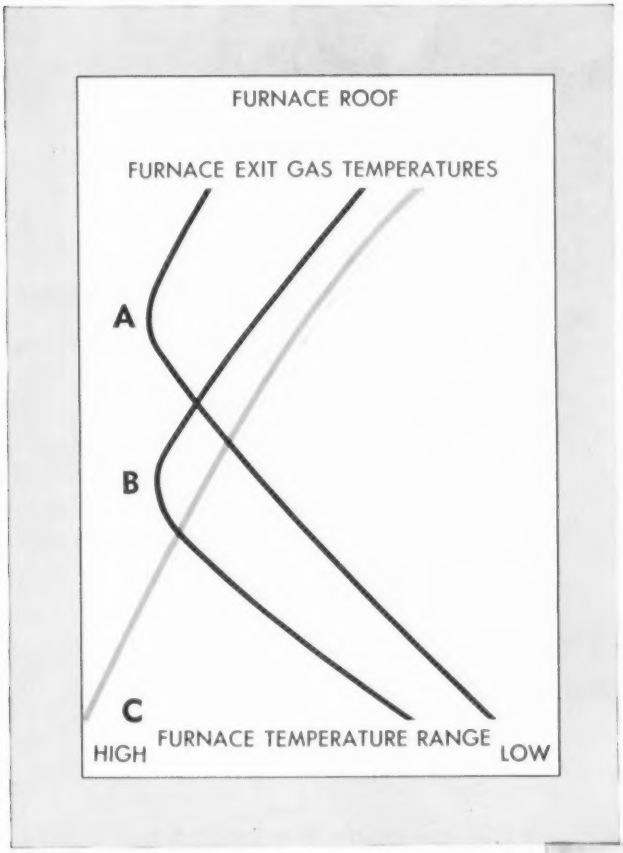


Fig. 2. Furnace temperature curves resulting from heat concentration at various furnace levels. (A) Above center of furnace (B) below center of furnace (C) bottom of furnace

Clean Furnace Walls — No Slagging

Since combustion takes place almost entirely within the furnace bottom very little flame ascends into the upper portion of the furnace. Gases rise vertically without impinging on furnace walls. Heat is released as gases travel toward the furnace exit, cooling to the point where danger of slagging of high temperature elements is reduced to a minimum.

Uniform Heat Distribution At Furnace Exit

A desirable characteristic of furnace performance particularly in larger boilers with wide furnaces is the even distribution of heat across high steam temperature components. In wide Turbo Furnaces this uniformity is furthered by the use of radiant tube platens.

Uniform Furnace Exit Temperatures With Multiple Fuels

The similar flame characteristics of oil, gas or pulverized coal, the completion of combustion in the confines of the furnace bottom, the cooling effects produced by the full utilization of furnace waterwall surfaces result in (1) uniform furnace exit gas temperatures with a given heat release per square foot of effective radiant surface and (2) a marked similarity in the exit temperature of the three fuels (Figure 3). These characteristics make possible the arbitrary use of gas, oil or a wide range of coals with a minimum amount of steam temperature control.

All Burners at Operating Floor Level

Another feature of the Turbo Furnace about which operating engineers are enthusiastic is the fact that all burners, with their supervision and maintenance, are located on one level. This feature permits the location of firing control on the turbine level.

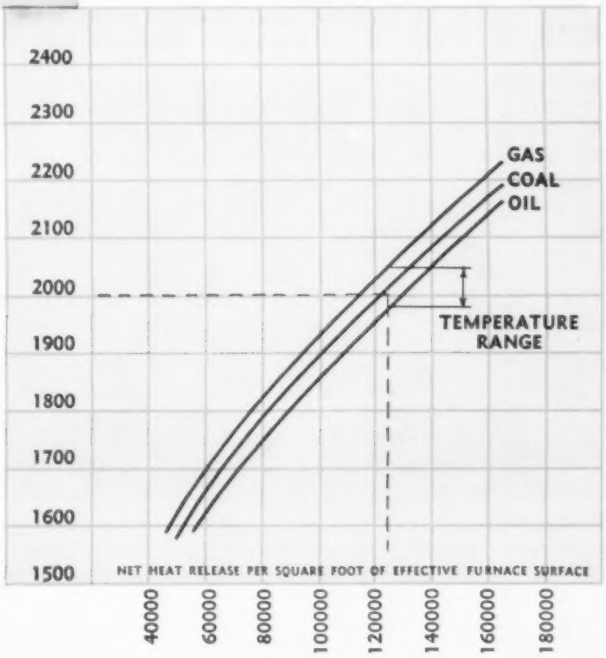
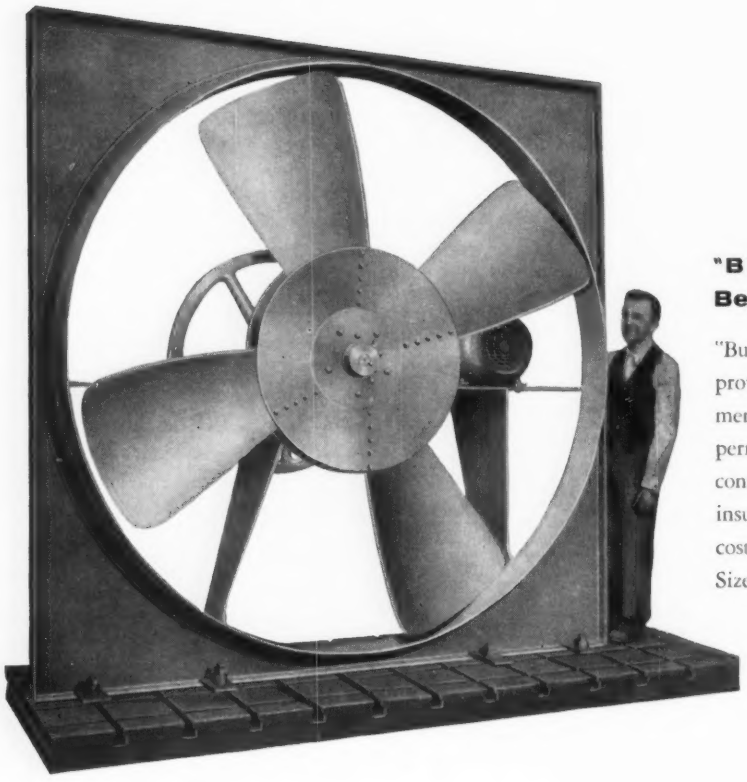


Fig. 3. TURBO FURNACE exit gas temperatures of gas, oil, coal have a maximum variation of approximately 50 F

A Riley engineer will gladly give you complete information about this latest Riley development. Write — RILEY STOKER CORPORATION, WORCESTER, MASSACHUSETTS



"BUFFALO" DESIGN 53
Belt-Air Package Propeller Fans

"Buffalo" Design 53 Package Propeller Fans provide high air volumes at low initial equipment and installation costs. High fan efficiencies permit extremely low operating costs. Rugged construction and outstanding design features insure long life and minimum maintenance costs. Capacities from 5,000 thru 250,000 CFM. Sizes from 24" thru 144" Diameter.

NEED BIG-VOLUME AIR CHANGE and/or HEATING?
HERE'S THE "BUFFALO" ANSWER IN ECONOMICAL "PACKAGES"!

From a boiler room's turbine room or transformer room to a foundry or an entire factory . . . "Buffalo" Heavy-Duty Propeller Fans and related package heating and ventilating units are economically performing jobs formerly considered unfeasible from a cost standpoint.

For full information, contact your nearest "Buffalo" Engineering Representative or write for Bulletins mentioned.

With convenient out-of-the-way roof installation, "Buffalo" Power Roof Ventilators save valuable production space. Because of their high capacity, the number of roof openings can be minimized, lowering construction and initial equipment costs. Choose from two models, the "Buffalo" Style "H" Sky Vent, above left — or the Style "V", above right. Both are available in wheel diameters from 12" to 120", and in capacities from 1000 to 250,000 CFM. Write for Bulletin FM-2345 today.

For providing make-up air in capacities up to 100,000 CFM, "Buffalo" Make-Up Air Units are proving the most economical buy. Available with provision for heating and/or filtering to the exact degree required. Write for Bulletin FM-2345.

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BUFFALO, N. Y.
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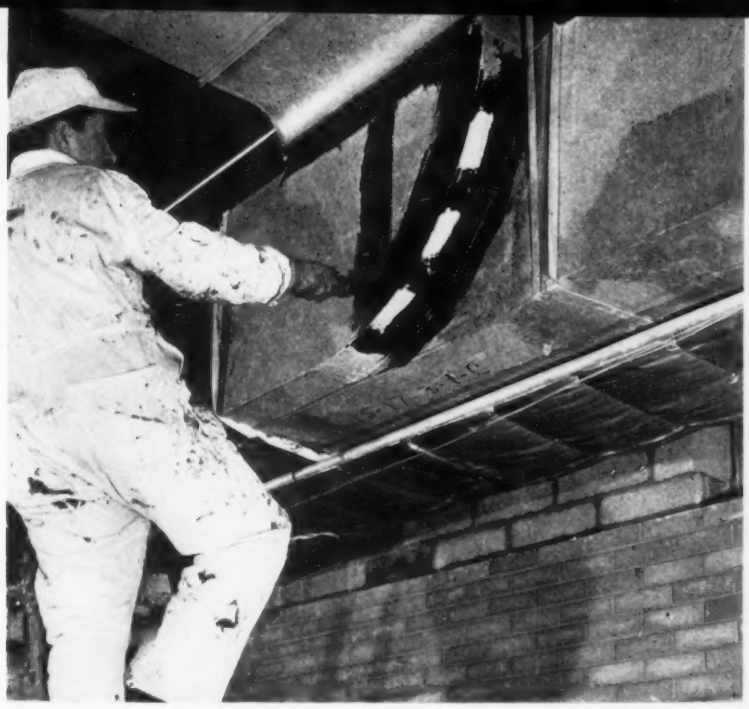
Plant maintenance and management section

STEVE ELONKA
Associate Editor in Charge



ADHESIVE applied to duct has a long open time, good wet strength to hold fibrous glass

Select the right coatings and sealers for power services

By B W SCHULTZ, Adhesive, Coating and Sealers division
Minnesota Mining and Manufacturing Company

Mastic type coatings, as used for today's power services, have a twofold job: to protect metallic surfaces against corrosion, and to seal insulation against penetration of rain and moisture vapor. When used over structural steel and other metallic surfaces, they build a barrier against water, air and fumes of most mild acids and alkalies. Applied over insulation, such as glass fiberboard, glass block, cellulose glass, magnesite, calcium silicate or similar insulating materials, they serve as weather-resistant coatings.

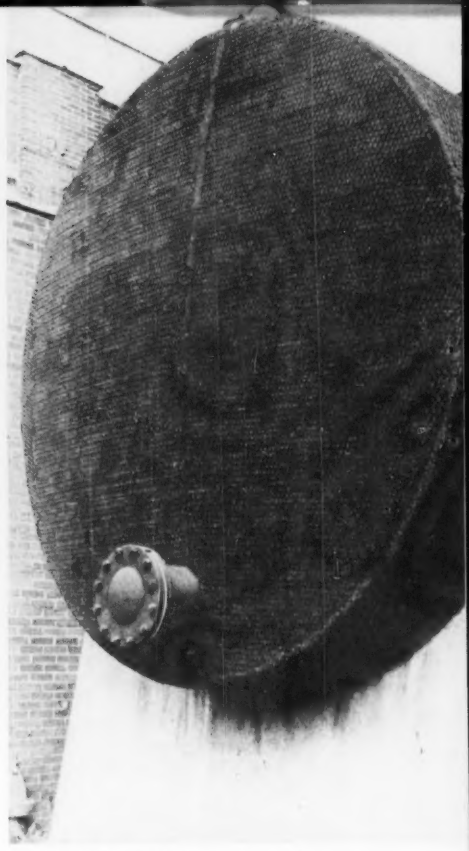
Here's what you can expect from a good coating:

Weathering. A good coating has high resistance to all kinds of climate and sunlight. Laboratory tests with exposures of 2000 to 5000 hours in weatherometer and salt-spray conditions, indicate what can be expected in accelerated aging of satisfactory coatings.

Chemical resistance. A primary use of coatings is to guard against hazards of chemicals and corrosion. So, they must withstand exposure to fumes, spillage and overflow of mild acids (hydrochloric, nitric, sulfuric, phosphoric), alkalies (sodium hydroxide), and tap water.

Fire resistance. Fire-retardant properties of a good coating are of top importance. A coating must be self-extinguishing when the source of the fire is removed. Turn page

SHEET-METAL HEAT DUCT is sealed before assembly. Sealer has excellent resistance to both water and oil, withstands continuous exposure up to 200 F without cracking



CHICKEN WIRE holds coating that protects against chemical fumes, weathering

You must consider all factors—from heat

Temperature resistance. Normal aging of a coating must be expected when it's exposed to continuous service conditions at 120 to 160 F. But, it must also withstand abnormal exposure to 350 F for short periods.

When exposed to freezing temperatures, a good coating will maintain adhesion to metallic surfaces and resist the tendency to crack and chip when receiving a sharp blow.

Tensile strength, ductility. You can count on a good coating to support the weight of the reinforcing membranes as well as its own weight. And, it will adjust to expansion and contraction changes occurring in the base structure.

Mvt rate. Main object of applying coating over insulating materials is to prevent water from passing to the insulation. A good moisture-vapor-transmission (mvt) rate is less than 0.0050 oz of water passing through 1 sq ft of coating in every 24 hours.

Application. Your coating should be easy to trowel, or to apply by spray with guns and pumping equipment engineered for the job.

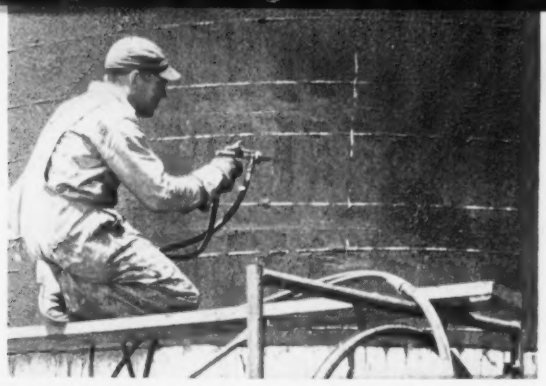
Before applying a coating to metallic surfaces, make sure surface is free from oil, grease, rust and moisture. Light sandblasting is one good way to tackle this cleaning job, although wire brushing, commercial metal-cleaning chemicals and solvent washing methods are OK.

On one East Coast assignment, we sprayed a mastic coating over some oil storage tanks and structural steel. The job was done during a sleet storm, with winds to 35 mph kicking up quite a fuss. Despite the corrosive sulfuric-acid atmosphere that the coating has been exposed to for the past 18 months, it's still in top shape.

You should use a reinforcing membrane, such as glass cloth or chicken wire, when coating over a weatherproof insulation. If the insulation is thoroughly dry, spray a skin coat over it and embed the reinforcing membrane. Then, smooth it out to insure against entrapment of air. Next, build up the coating to the desired thickness by spray overcoating. This impregnates the membrane completely and seals the insulation in one application.

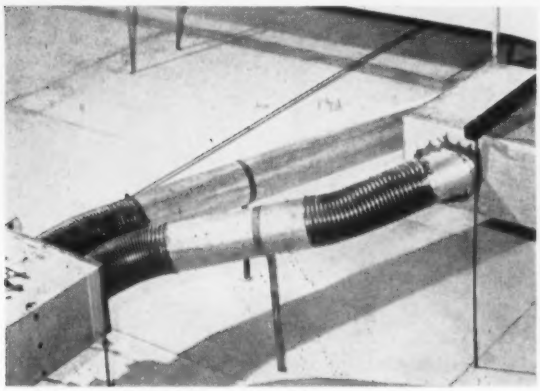
The approach is somewhat different when applying weatherproof coatings over insulation while the base structure is cold. Here, as the structure heats up, you must drive out any water vapor that has been absorbed by the insulation before completing the seal. If you don't, bubbles of water vapor will form under the protective coating.

In this case, apply a skin coat and embed a reinforcing membrane as before. Allow the system to dry at least 24 hr before spraying on the final coat to obtain the desired thick-



SPRAY COATING, applied as protection against corrosion and abrasion, seals over insulation, keeps out both rain and vapor

VINYL-FACED fibrous glass is adhesive bonded to galvanized-steel duct. Dry adhesive stays flexible, stands up to 375-F service



FLEXIBLE DUCTWORK must be sealed tightly at joints to avoid air leaks. Sealer withstands continuous exposure up to 200 F

FOAMED-GLASS BLOCKS are bonded to the tank. Seams are caulked and protective coating is sprayed over the insulating blocks

and weathering to chemical resistance

ness. The coating can then breathe, allowing for moisture vapor transmission.

We faced another tough job in a Midwest power plant where mastic coating was to be applied over monoblock insulation. The insulation had been exposed to damp rainy weather and was thoroughly saturated with water. Keeping this in mind, we applied a skin coat and embedded the reinforcing membrane. Temperature of the base structure was raised to the operating level. After 24 hr, we applied another skin coat and embedded a second membrane. This also was allowed to dry for 24 hr.

During the drying period, we kept the structure at operating temperature, allowing the coating to breathe. (When insulation is hotter than the surrounding atmosphere, it has a tendency to evaporate moisture rather than to absorb it.) After 24 hr, we sprayed on the final coating to obtain the desired thickness and seal the insulation permanently.

Sealers. Some versatile sealers used for today's power services have a poly-sulfide rubber base. By adding an accelerator, they chemically cure to a tough rubbery solid. These sealers are noted for their long service life over a temperature range from −90 to +225 F. Their resistance to weathering, water, petroleum products and most solvents make them a smart choice for sealing vibration isolation joints of dynamometer foundations. They also have been used successfully as (1) watertight sealers for riveted joints (2) oil-resistant and moistureproof barriers (3) patches for sealing joint leaks of gas mains from the inside (4) fuselage and integral fuel tank sealants by the aircraft industry.

An interesting application finds poly-sulfide rubber-base sealers used on expansion joints where they come in contact with either concrete or metal. Here, they exhibit tensile strengths in excess of 500 psi, and give or elongate over 450%.

Another unique material is a synthetic-rubber tape-form sealer, reinforced with fabric. This product offers several advantages over mastic-type sealers. It contains no solvent, so toxicity, fire hazard and shrinkage problems are minimized. Further, it's supplied in handy rolls of desired width and is easy to apply.

This sealer was developed originally for the house-trailer industry—as a watertight gasket-like seal around window and door frames, or where side and roof panels are screwed or riveted to structural members. But, you can adapt it to many other jobs: Use it as flexible gasketing, sealing between metal sheets in prefabricated sheet-metal buildings or as an antisqueak buffer between metal sections in vibrating equipment.

Automatic lubrication cuts hazards and can...

Chop 90% from coal-handling costs

By L M LIVINGSTON, Bakelite Co, Div of Union Carbide Corp

How many times have you looked over the coal-equipment weekly-inspection sheet and found noted thereon that the coal-conveyor jack shaft and bearings are very sloppy and need replacement? Or perhaps a few idler rollers are stuck, or the feeder bearings should be replaced? So you schedule the bunkers to be filled on the night shifts and line up the maintenance crew to make repairs the next morning. After taking care of those details you start sweating it out until repairs have been made and your coal-handling equipment is perking along once more.

Aside from the fact that coal-handling equipment repairs can be costly from both a parts and a time standpoint, any outage can disrupt operating-crew schedules to a considerable degree. And outages, even for minor failures, build concern in management's mind that failing equipment may go undetected, result in a serious breakdown at an inopportune time. We all know how vital the equipment is to plant operation and how service interruptions contribute to early gray hairs for the chief engineer.

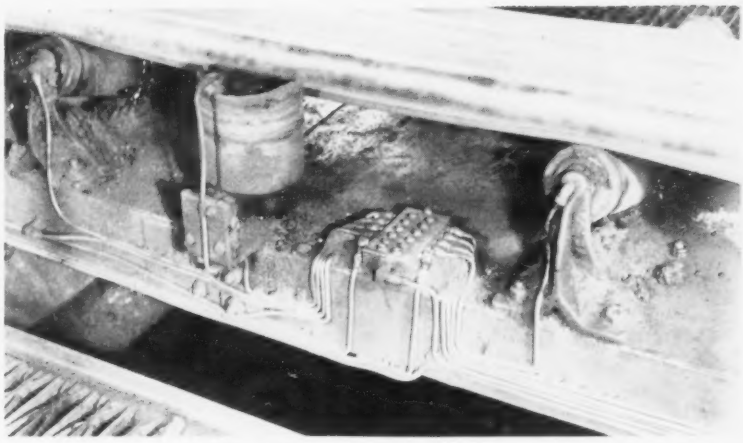
With the stage set in this somewhat gloomy fashion, you're probably in the proper mood to investigate the possibilities of getting relief from the problem. Relief may lie in a scheme that can eliminate much concern for bearing failure and cut maintenance costs to the bone. It's an automatic lubrication system and, frankly, we wouldn't be without it.

Our coal-handling equipment consists of a track hopper, reciprocating feeder, bucket elevator, inclined-belt conveyor and an in-bunker traveling-belt distributing conveyor. System can handle 40 tons per hour. Formerly, lubrication, adjustment and replacement of bearings, shafts, etc was costing us $3040 for labor alone (1071 man-hours for lubrication plus 145 man-hours for repairs with labor at $2.50 per hour). Material costs aren't included in this figure.

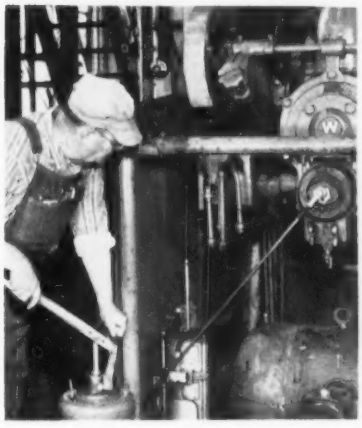
We installed an automatic lubricating system (cost: $4830) to serve 134 grease points. We use a light general-purpose grease during warm weather and, for winter operation, cut this grease with SAE 20 lubricating oil. Results exceeded our fondest expectations from the very beginning. Reliability, starting ease in cold weather and complete elimination of bearing and shaft replacements easily justified the system. Cost for the first year of operation was $300 for labor. This included 35 man-hours to fill the reservoir and 85 man-hours to make initial adjustments with labor at $2.50 per hour. Subsequent annual costs should show even greater savings, but any time you can install a system that'll pay for itself in less than two years, it's worth shouting about.

We also installed an automatic lu-

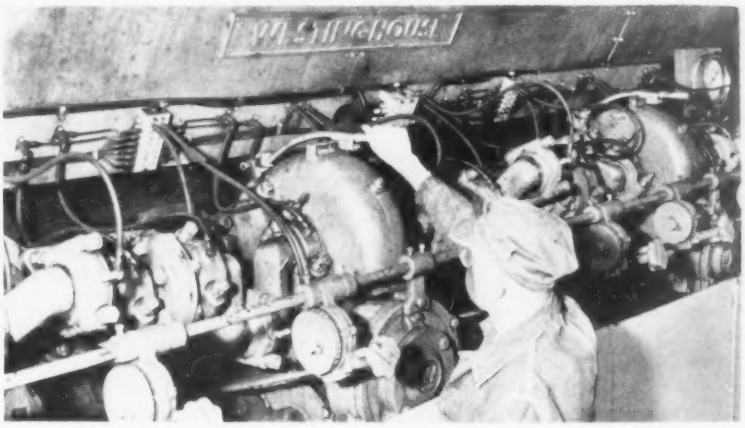
FILLING RESERVOIR for coal-handling equipment lubrication system is done in jig time from ground level, cuts climbing hazard



COAL CONVEYOR roller and idler bearings get constant adequate lubrication. Automatic system pays for itself in less than 2 yr



STOKER LUBRICATION system cost $3420 to install, has cut annual maintenance labor expense from $2145 to an insignificant $150



BEARING REPLACEMENT drops to zero on stokers. System proved that daily manual lubrication, though conscientious, wasn't enough

brication system (total cost: $3420) on each of two multiple-retort underfeed stokers. Operational improvement and elimination of maintenance on rotating parts was little short of surprising. It proved one thing beyond a doubt: manual daily lubrication couldn't keep grease where it was needed all the time.

In choosing our system, we specified only that it have simplicity of design, have positive operation and assure lubrication on each terminal. Besides these features, our system is adjustable for quantity of lubrication and has safety disks to protect against overpressure.

During start-up we used an excessive lube feed to flush lines and bearings. After a couple of days we reduced feed to an amount sufficient to maintain adequate lubrication and to keep the bearings clean. Overall operation has been satisfactory in every respect.

Safety, of course, can't be measured in dollars and cents. We can't estimate how much we've saved by eliminating hazards of climbing and crawling over, under and around the equipment to reach lubrication points.

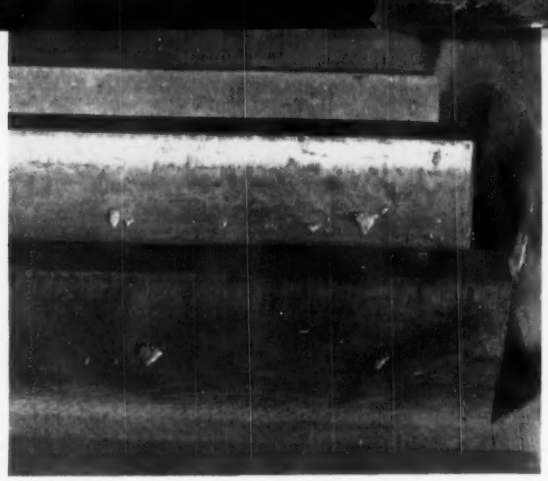
Cost breakdown showed that maintenance men were spending more than three days a year just climbing and crawling when servicing the equipment. Add to this the 992 hours per year spent wiping and lubricating fittings and the 145 hours per year to adjust or replace bearings and it shows an annual labor cost of $3040 for coal-handling equipment alone.

Lubrication-system installation cut equipment's annual maintenance cost to a mere 10% of what it used to be. Even at this rate, savings will pay for system's installed cost in 1.71 years.

Same is true, only more so, of automatic lubrication for the stokers. Annual maintenance cost (labor only) of $2145 has been slashed to $150—just a trifle more than 7% of what we were paying. This system will pay for itself in about a year and nine months. As stated, these figures don't include savings on equipment parts. Undoubtedly we'll have to replace a bearing here and there as time goes by, but this expense will be peanuts, too, as compared to our former annual costs.

PART 3 OF A SERIES

By E S REYNOLDS and J R HICKS, Socony Mobil Oil Co, Inc



METAL FATIGUE often causes pitting or spalling like this. It starts below the pitch line and is usually confined to that area

What your eye can tell you about

Industrial gears are designed and built for long life. If installation, run-in, lubrication and maintenance are satisfactory, and speed and load are within the design range, you usually get long life. But some gears do fail prematurely. This may be caused by tooth breakage, but more commonly it is a result of tooth-surface damage.

Replacing gears is expensive. If a machine must be taken out of production, the cost of lost production may be far more than mere replacement cost.

When gears fail, the tooth surfaces exhibit many patterns, such as spalling, pitting, scoring, scratching, peening, etc. There are many such names, and different people may apply the same name to different failure patterns.

However, as we mentioned in Part 2 of this series, POWER, April 1958, pp 120-122, there are five basic causes of gear-tooth failure: (1) original surface roughness (2) mechanical damage (3) abrasive contaminants in the lubricant (4) metal failure (5) lubrication failure. We discussed the first three of these causes in Part 2. This article discusses the fourth cause, metal failure, and the last article in the series will deal with lubrication failure.

Metal failure is most commonly caused by fatigue. It may result in formation of pits or craters, surface cracks and, sometimes, broken teeth. Gears made from soft metal may fail through plastic flow of the surface metal.

As we pointed out in the first article in this series, POWER, February 1958, pp 116-119, the "line of contact" between gear teeth is actually a band of contact because heavy unit loads cause elastic deformation of gear metal as teeth mesh.

Consider the situation at the pitch line of a spur or helical gear where the motion is pure rolling—no sliding. Metal in the band of contact is in compression. Below the surface, metal is squeezed ahead of and behind the band. Therefore, it is subjected to shear stress. A wave or bulge is formed ahead of and behind the contact band, and the surface metal in these areas is in tension.

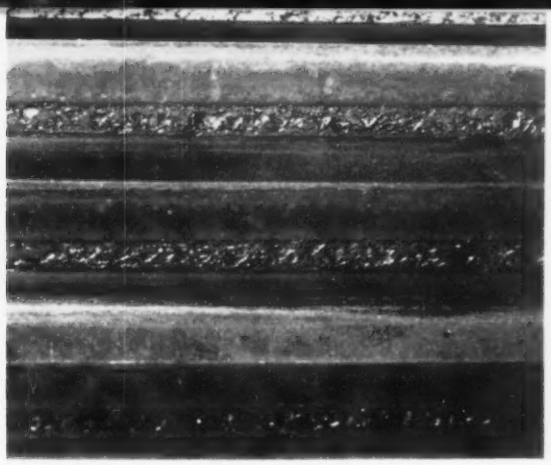
In other contact areas toward the tips and roots, gear teeth slide as well as roll together. The resulting frictional drag affects elastic deformation of the metal and imposes additional shear and tension stresses.

We need not be concerned with the changing stress pattern as a tooth goes through mesh. The important thing is that each bit of metal in the contact area, down to some distance below the surface, is subjected to compression, tension, and shear stresses every time the line of contact passes over it.

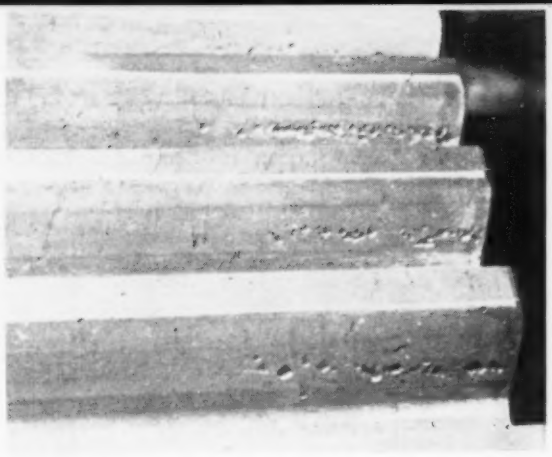
Gear failure may be caused by metal fatigue. Fatigue endurance limit is related to the hardness and strength of the metal. In general, if tooth surface stresses are below this limit, the gear runs indefinitely without fatigue failure. On the other hand, if surface stresses are above the fatigue endurance limit, fatigue failure occurs after a sufficient number of stress repetitions. This type of failure usually involves a long period of operation—often years. Look for other causes when short-term failures occur.

A common result of fatigue failure is formation of relatively large craters or pits, photo above. Whether the craters form by single pieces of metal spalling out or by smaller pits joining together is not usually determined. The terms spalling and pitting are both used to describe this type of failure.

Fatigue cracks may start below the surface, see top magnified view on facing page. In this instance, the cracks were at a depth where the shear stress caused by compressive loading was maximum. In a case-hardened gear, if the depth of case is less than the depth of this maximum shear stress, cracks may start



PITTING may continue until the entire tooth flank below the pitch line is spalled. It may also extend above the pitch line



MISALIGNMENT can cause heavy loading, fatigue failure, pitting below pitch line at the tooth ends. Note pattern of damage

gear failures

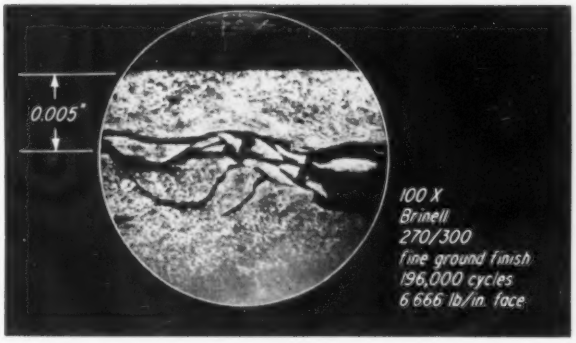
between the case and core. Cracks that start below the tooth surface eventually break through to the surface, see bottom magnified view. In time, metal above the shear crack separates and drops out.

Fatigue cracks can also start at the gear-tooth surface (as a result of tensile stress) and proceed down to meet or start shear cracks. Oil gets into these surface cracks and is subjected to high pressure each time the band of contact passes. Some investigators believe this action helps to extend the cracks.

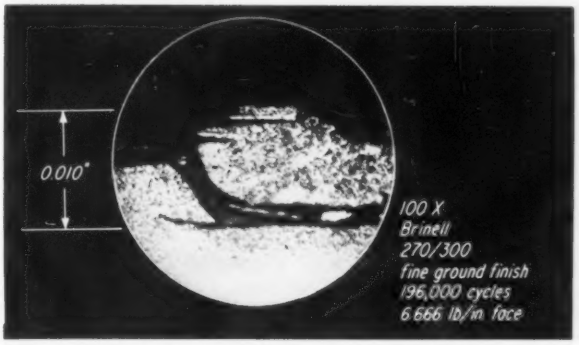
Spalling of tooth surfaces ordinarily develops first on a driving pinion rather than on a gear. A pinion usually has fewer teeth: thus each tooth is subjected to more stress repetitions than the driven-gear teeth. Furthermore, spalling usually occurs below the pitch line because: (1) Involute tooth radii are short in this area, thus resulting in high compressive stresses. (2) Gear teeth act as short cantilever beams, and surface tensile stresses caused by beam loading are high in the flank area, especially near the root fillet.

Pitting ordinarily starts where the combination of stresses is most severe. Location of this point in the flank area depends on gear design and accuracy. It may be at the first point of contact (nearest the root of

Surface pits grow from minute cracks

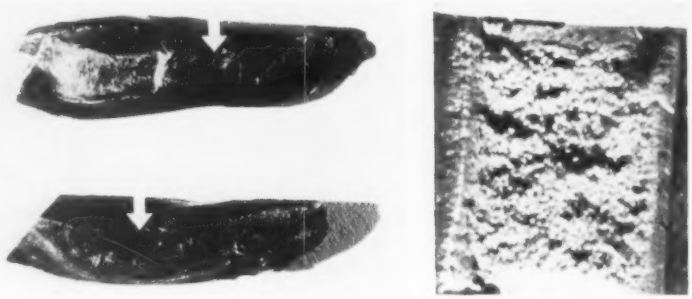


FATIGUE CRACKS may start below the metal surface at a depth where shear stress caused by compressive loading on gear tooth is high

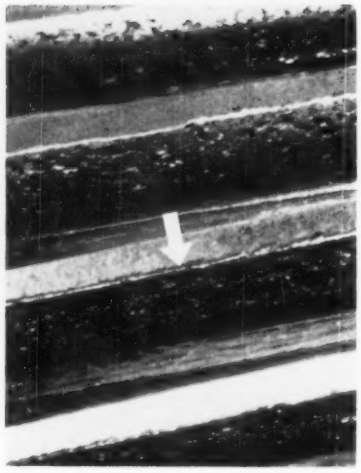


EXTENDING UPWARD, crack finally breaks through the tooth surface. In time, metal above crack separates and drops out, leaving a pit

Fatigue or shock loads may break teeth



BROKEN TEETH tell a story. Fatigue breaks *left* are smooth. These started at defects marked by arrows. Sudden breaks *right* look coarse, granular; are caused by shock loads or mechanical damage



PLASTIC FLOW of gear metal that is too soft may result in a feather edge *arrow*

the driving tooth), at an intermediate point or at a point only slightly below the pitch line. From any starting point, pitting can continue until the entire flank area is spalled, left photo, top of page 107. Pitting can even extend above the pitch line. Right photo, p 107, shows a test gear in which a heavy fatigue-causing load was the result of intentional misalignment. Pits are well below the pitch line. The pattern of tooth damage frequently reveals misalignment if it exists.

In worm gears, the spalled areas are commonly at the outgoing side of mesh. At the outgoing as compared to the incoming side of mesh, the oil film is thinner and the oil and metal surfaces are hotter. Fatigue resistance of a bronze worm gear decreases rapidly as temperature increases. Unless there is misalignment, signs of heavy loading may be apparent over the entire tooth surfaces.

Neither increased oil viscosity nor use of anti-wear additives can prevent premature spalling or pitting failures. Such failures occur when the gear metal is not hard enough and strong enough for the load or where the gears are not big enough for the job.

Occasionally, a relatively large piece of metal flakes off near a tooth tip or corner of a spur or helical gear. This failure, which usually occurs after a short period of operation, is not caused by fatigue but by residual stresses that are present because of improper heat treatment. This is sometimes called spalling, although it is quite a different matter from the spalling that we previously described.

In case-hardened heavily-loaded gears, fatigue failure may take the form of cracks running more or less parallel to the gear axis. Most of the cracks are concentrated near the bases of the teeth where tensile strength due to beam loading is highest. The surface metal's tendency to crack may be overcome by shot peening, which increases the beneficial surface compressive stress over that provided by case-hardening alone.

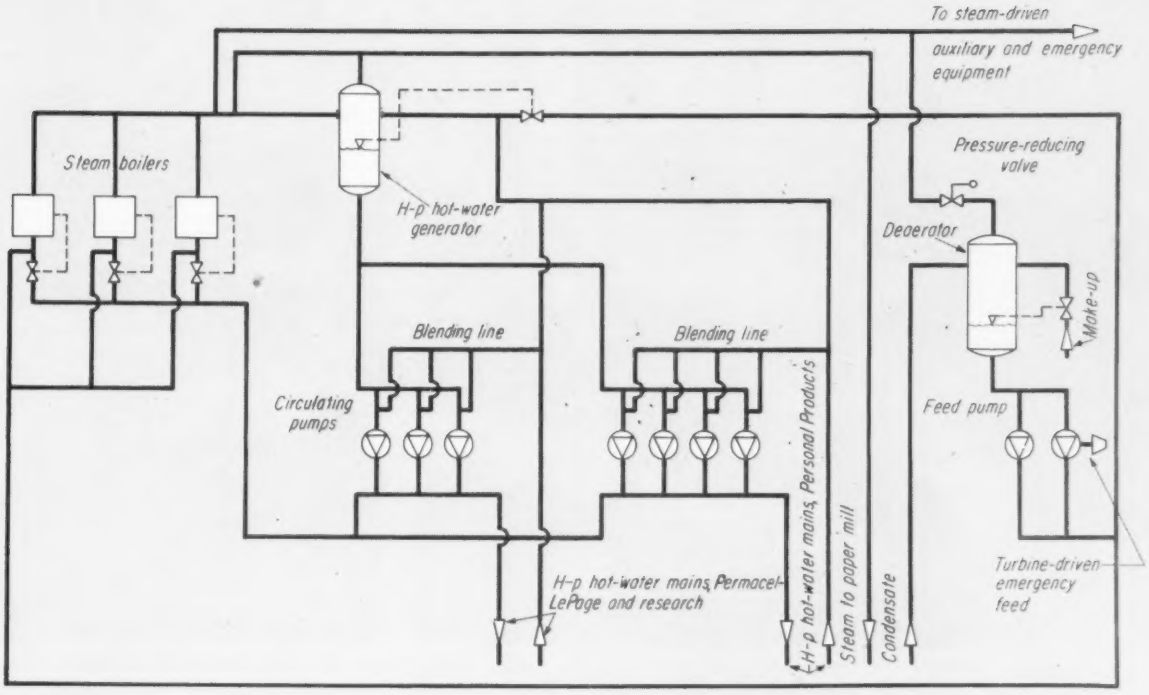
Tooth breakage. Sometimes an entire tooth breaks off because of metal fatigue, left photos, above. A fatigue crack normally grows very slowly, and the surface at the break is quite smooth. Finally it reaches a certain point where the tooth is so weakened that the final break is sudden. The surface of the sudden break has a coarse granular appearance as at the right of the lower tooth in the photo. If the entire surface at a break is of a coarse granular nature, center photo, a sudden break caused by shock load or mechanical damage is indicated.

Plastic flow. Stresses associated with the movement of the contact band may exceed the elastic limit of metal that is too soft. When this happens, you get plastic flow, and metal may be rolled and dragged beyond the tooth tips, right photo. This is often called feather edging. Where shock loads are involved, soft metal may be pounded out at the sides of gear teeth. This is ordinarily referred to as peening.

Plastic flow of soft metal is not a fatigue failure. The latter usually occurs after many cycles of operation over a long period; plastic flow can occur in a relatively short period. Neither is it a lubrication failure, but there have been cases where it has occurred after hard surface metal has been worn away by abrasives in the lubricating oil.

Metal that is too soft is neither desirable nor recommended for gear service. However, inadequate design or errors in metallurgy or heat treatment may sometimes cause it to be used.

In the next, and last, article of this series, we will discuss gear failures resulting from lubrication deficiencies, and from combinations of several causes, such as simultaneous lubrication and metal fatigue failure, which can occur when tooth loading is heavier than either the oil or the metal can withstand. Watch for it in a forthcoming issue.



Operation smoothed, higher steam demand met by converting to...

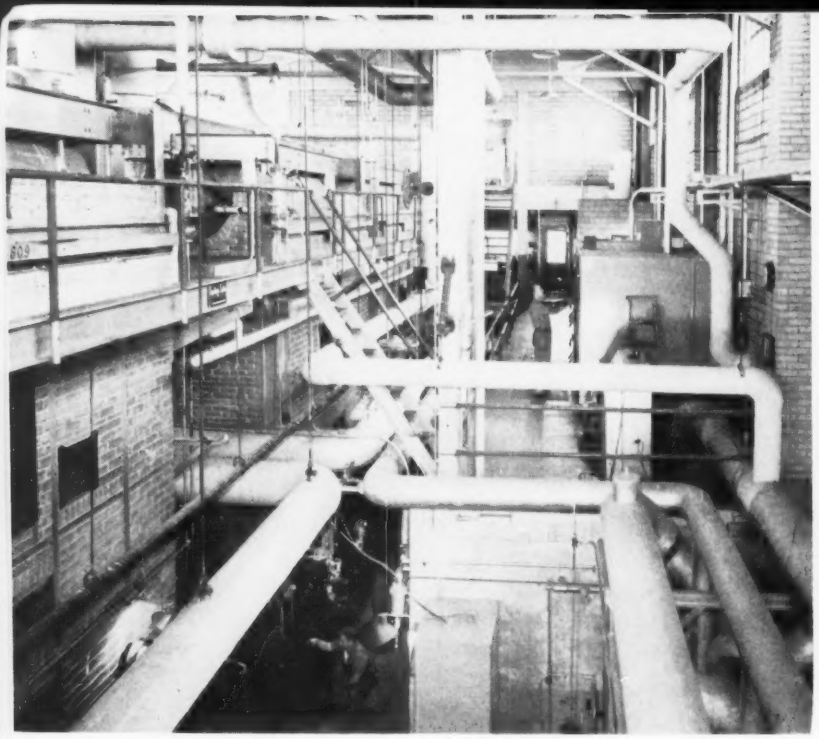
A flexible high-pressure hot-water and steam boiler plant

By E G HANSEN, J O Ross Engineering, Div of Midland-Ross Corp
and WILLIAM LIDDY, Personal Products Corp

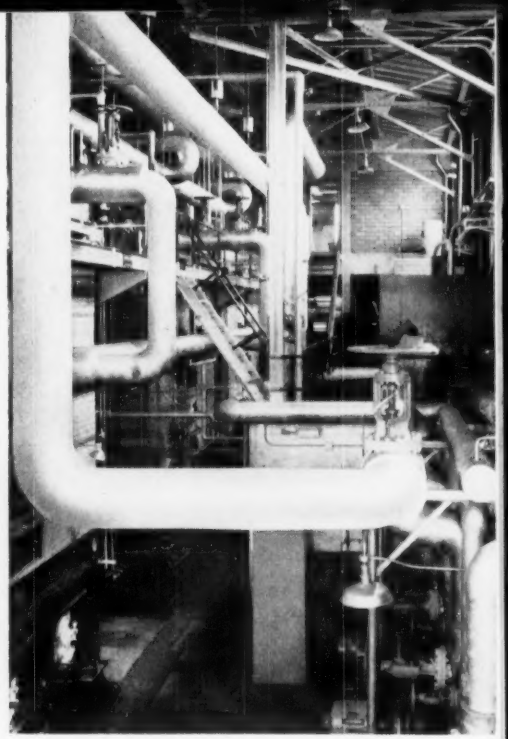
A recent conversion of existing boilers at Personal Products Corp's Milltown, N. J. plant produced some necessary results that weren't formerly possible: (1) All three boilers can operate simultaneously if desired. (2) Water levels of two paralleled boilers are consistently balanced during normal operation to provide high-pressure hot water for plant's process-heating needs. (3) Extra steam is obtained for increased capacity of two Yankee dryers.

To bring the overall picture into focus, let's go back momentarily to 1939. Construction of one of the country's first systems designed from the bottom up for high-pressure hot-water service was getting under way. In 1940 it went into operation using a single 3-drum watertube boiler designed for 200-psi steam but modified to supply h-p hot water. System design provided for two distinct loops, each with its own circulating pumps. One loop, having 8-in. mains, served the Personal Products plant adjacent to the boiler house; the other, with 10-in. mains, served the ¾-mile distant Permacel-LePage Corp plant and the Johnson & Johnson (the parent company) reseach lab a ¼-mile beyond. End of the longest main is about 5100 ft from the boiler room and the system's highest point is 79 ft above boiler-room floor level. With the normal water level of the steam type boiler about 22 ft above the floor, this put the system's static head at this level at about 57 ft.

Boiler modification consisted of installing a longitudinal baffle and two nozzle-and-dip-pipe flow and return connections in the top rear drum. This drum also served as system's expansion tank. The original boiler design included a small steam header located above the front drum and



STEAM BOILERS, operated as flooded units for h-p hot-water system, are converted back to steam generators but still form closed loop with system, retain all former advantages



BEFORE CONVERSION boilers had individual flow, return and water balance lines

BOILER PLANT continued

connected to the rear drum by a single row of tubes. Since steam flow through these tubes would be insignificant, a monolithic baffle was installed to protect them from overheating. However, the header supplied the small amount of steam needed in the boiler house — fuel-oil heating, soot blowing, etc — and to operate emergency standby turbine-driven fire and boiler-feed pumps.

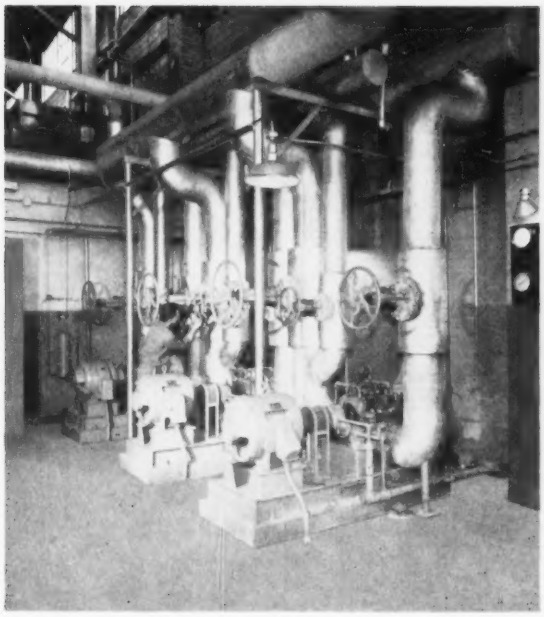
Heat use was, and still is, mostly for process with some space heating in winter. Large quantities of process steam needed by Permacel-LePage were generated in heat exchangers. The 100-psi steam supply to two Yankee dryers at Personal Products Corp's paper mill came from other exchangers located in the basement below the dryers.

With 43.5-million-Btu-per-hr capacity, the boiler served the system economically and satisfactorily. Saturated water at 195 psi, with steam temperature of 382 F, was drawn off just below the water line, circulated through the system and returned to the boiler. Despite the pipeline distances, water temperature loss was only a few degrees, giving high process temperatures. Process-heating peaks never presented a problem; they were absorbed by the system's heat-storage capacity.

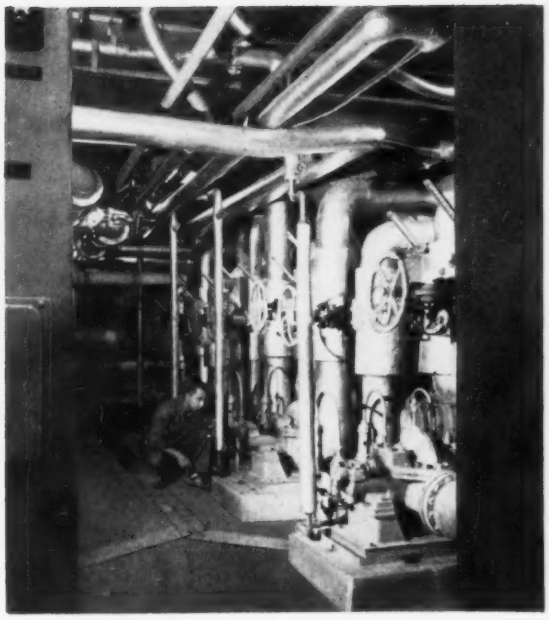
Plant production increases, with corresponding demand for more steam and process heat, resulted in installation of a second similar boiler in 1945 and a third in 1950. When the second boiler went in, a problem presented itself: it was difficult to hold balanced water levels even though the paralleled boilers were fitted with equalizing or "water balance" lines. To clarify this, remember that a pressure difference of only 1 psi represents a water-level difference of 2.65 ft, so uneven firing or a slight change in the water-distribution pattern to the boilers caused one unit to flood while the water disappeared from the other. Normal operation didn't cause any particular difficulty, but soot blowing was always a delicate job. And bringing a boiler on or off the line was a major operation. This would take up to six hours with a man on top of each boiler constantly adjusting valves. Such difficulty with two paralleled units made it obvious that simultaneous 3-boiler operation was out of the question. Equally obvious was the fact that this situation wouldn't permit a further operating capacity increase. Another drawback was short circuiting under the longitudinal baffles in the rear drums. Because of this, actual water temperature was always at least 3 deg lower than saturation temperature. And, for equal pressures, there was often a 6 deg water-temperature spread for different boilers.

Adding to these difficulties, the Yankee dryers' speed was being increased steadily, and their heat exchangers were beginning to drag anchor. Barely able to hold existing dryer-steam demand and unable to bring a dryer on the line from cold in less than an hour, the exchangers just didn't fit into the future scheme. Existing dryer speed was slated to go up in addition to installation of new, higher-speed higher-steam-pressure units. Installing new higher-capacity steam-generating heat exchangers wasn't feasible economically. Something had to be done.

The solution. The boilers were converted back into steam generators.



CIRCULATING PUMPS supplying h-p hot water to Permacel-Le-Page and research lab about a mile away are on one of two loops



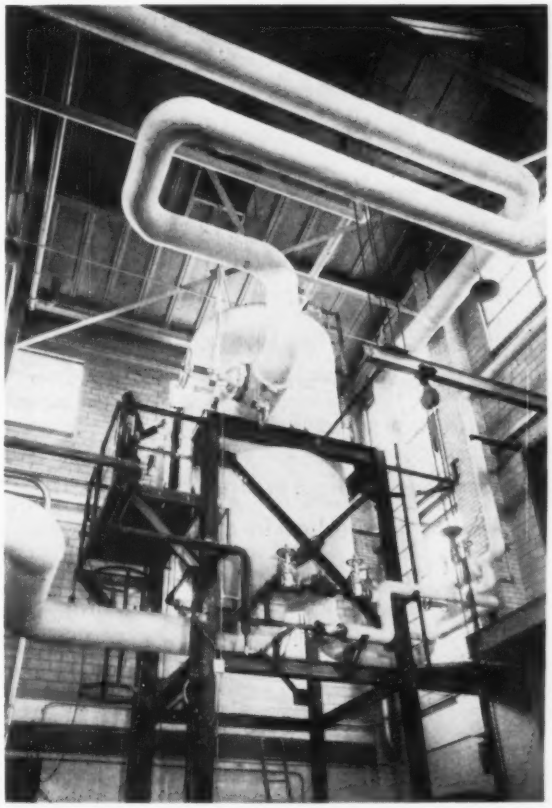
ANOTHER LOOP, served by these pumps, supplies Personal Products plant adjacent to boiler house. Pump sets also feed boilers

Out came the drum baffles, h-p hot-water nozzles, water-balancing lines and the protective monolithic baffle under the steam tubes. Connections between steam drums and existing steam manifold were increased from 6 to 8 in.

H-p hot-water flow and return lines were relocated to a new 7-ft dia, 15-ft high direct-contact h-p hot-water generator. A steam line from the boiler manifold enters the upper part of the generator and the lower part serves as an expansion tank. Pressure in the generator is the same as steam pressure in the boilers.

A new boiler-feedwater header, connected to the h-p hot-water system circulating pumps' discharge header, gives the pumps the additional duty of assuring boiler feed with water from the system. The boilers have new feedwater controllers which permit them to draw on the system as needed.

Though the boilers are now steam generators, they still form a closed loop with the h-p hot-water heating system and none of the system's former advantages are lost. Actually there are (*Continued on page* 176)

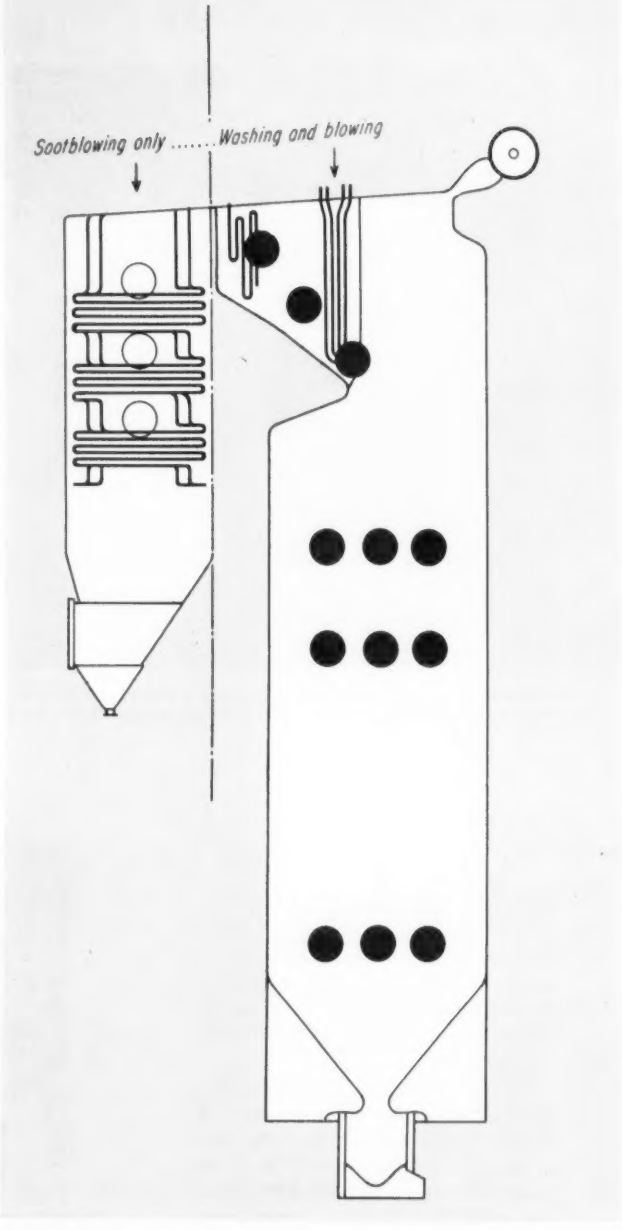


DIRECT-CONTACT h-p hot-water generator supplies entire system, serves as expansion tank, handles return condensate, provides feed

By M E MARSHALL Plant Superintendent
Long Island Lighting Company

Soot blowers shock slag with h-p water, slash boiler outage

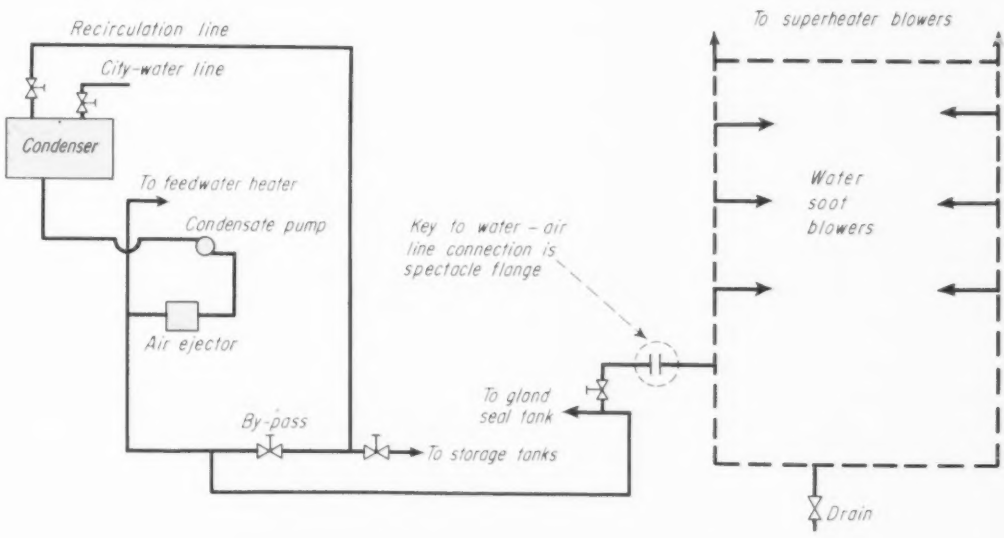
- Soot-blower washing setup gives Long Island utility a quick, safe way to deslag hot boiler and furnace sections
- They've done away with costly hand washing, slashed outage time to 4 or 5 hours
- Maintenance men are kept out of boiler during the washing operation, away from the dangers of falling slag
- Boiler never loses full pressure, can be brought back onto the line in a hurry



BLOWERS shown by dark circles are used for washing operation. Soot blowers in cooler furnace parts aren't needed to control slag

Power engineers have long sought a way to get around the costly, dangerous hand-washing methods of removing slag and ash from boiler sections. We've beat the rap in our Long Island plant by washing slag-fouled boilers with soot-blowing equipment.

Use of soot blowers for boiler washing has chopped our outage time to 4 or 5 hours. And, we can do the job during low-load periods, such as a week-end evening. Just as important, our maintenance men no longer have to enter the furnace before deslagging, thus they are kept away from falling chunks of slag weighing up to



Put a watchdog in your water-air line

Condensate and air line may be connected in many ways; schematic shows one possibility. Isolate heaters and storage tanks. Break into water line and lead a small (2 or 3-in.) connection to soot-blower air line. Remember to include a sure-fire device so water can't enter hot furnace if someone turns wrong valve. Spectacle flange makes a good watchdog; is sure, simple.

Seal off air tanks and purge blowers of pressurized air. Bring raw water in steam side of condenser. After deslagging, drain water and reverse the flange.

500 lb each. The soot-blower washing method also provides faster boiler cooling and removes dust. As our foreman sums it up, the men work with a feeling of security since the furnace is a safer work area.

Thermal shock is the key to the success of our soot-blower washing setup. Before our boiler is taken off the line, pressure is worked down from 2000 psig to about 600 psig. Waterwall temperature is kept close to the 450-F mark—hot enough to thermally shock the slag, yet cool enough to prevent damage to the tubes. When slag is shocked by the cool water, it cracks and falls free of the tubes.

Efficiency of this scheme depends on location and number of soot blowers. At our plant, we can knock down all visible slag. However, boiler washing in your plant may not produce such good results; each installation must be studied carefully.

Before taking the boiler off the line, its ash hoppers must be emptied, soot-blower compressors and air tanks are isolated, and pressure in the blower lines is relieved. Also, condensate and soot-blower lines not needed for washing should be isolated to prevent raw-water contamination. We connect condensate and air lines with a 2-in. tie, breaking into the condensate line near the gland-seal tank. Then we install a spectacle flange in the tie. During normal boiler operation, the blank side of the flange is in the line. But, before washing starts, this flange must be reversed to get water to soot blowers.

Raw water, brought into the condenser's steam side, is used for washing. Since our condensate pumps deliver far more flow than needed or desired for washing, recirculation valves are left wide open.

Washing procedure starts with the lowest wall blowers, and other blowers are used in order of their elevation. Since our blowers are controlled manually during washing, the automatic relay for long retracts is disengaged. (This relay acts to remove retracts from the boiler upon loss of air pressure and will interfere with the washing operation if not cut out.)

Once the deslagging operation is completed, raw water is drained from the hotwell, condensate and air lines. Return piping is hooked up in its normal fashion. In working up a procedure for your plant, *don't overlook* importance of reversing the spectacle flange.

Water consumption in our operation varies between 15,000 and 26,000 gallons, depending on the time it takes to complete the washing and the number of blowers used. If the boiler is fouled badly, more than one washing cycle often is needed to clean the unit. This takes a heavy toll on the amount of water used.

Turn page

Here's 4-hr washing setup for our No. 10 boiler

I. Preparations with unit on the line — Time, am

A. Ash system
1. Empty all flyash hoppers; check each hopper. Repeat if necessary — 1:00
2. Inspect rear pass hoppers, leave four end plates open — 1:15

B. Soot-blowing system
1. Secure soot-blower air compressors with tank pressure at 500 psig — 1:16
2. Close motor-operated valve in air-supply line to soot blowers — 1:16
3. Relieve pressure on soot-blowing air lines, after motor-operated valve, by operating wall blowers — 1:16

II. Preparations with unit off line

A. Boiler-feed and condensate system
1. After high drum level is established, close motor-operated gate valve to boiler-feedwater control valve — 1:20
2. Close discharge valves on condensate transfer pumps and open circuit breakers — 1:25
3. Close excess condensate guard and by-pass valves to condensate storage tank to prevent contamination — 1:25
4. Close guard and by-pass valves on condensate regulator to gland-seal tank — 1:25
5. Check tie-line. Spectacle-flange position between condensate and soot-blowing air lines — 1:30
6. Open valve in 2-in. tie line — 1:30
7. Open condensate recirculating valve wide to condenser — 1:30
8. Open all three boiler-feed-pump recirculating valves to condenser — 1:35

III. Boiler-washing procedure

Washing of boiler is to be started after the unit is off line and when the drum pressure has dropped to less than 600 psig. With normal drum level established, wash boiler as follows:

1. Control raw-water valve to fill condenser hotwell — 1:50
2. Start one condensate pump and record its discharge pressure at the boiler-feed pump suction-pressure gage — 1:50
3. Wash furnace by blowing wall-band deslaggers manually and in sequence from soot blower controls on the recorder board. While washing furnace, control hotwell level by operating raw-water valve — 2:50
4. When blowing retracts, after each retract starts in, cut out the automatic-retreat relay in back of recorder board by actuating toggle switch provided, otherwise relay will retract blower — 3:40
5. Have bottom ash-removal system in service continuously while washing boiler — 1:50
6. After washing is completed, make an inspection of the walls. If necessary, repeat the washing operation, then recheck walls — 3:40

IV. Post-washing items

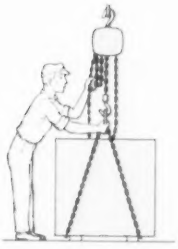
Once washing of the boiler is completed:
1. Secure raw-water valve to the hotwell — 3:40
2. Drain hotwell of raw water — 4:30
3. Close the 2-in. tie-line valve between condensate and soot-blowing system. Tag this valve for watch-engineer's information — 4:45
4. Return automatic-retract relay to normal operation by resetting toggle switch to normal position. Relay is a safety interlock feature which removes long retracts from boiler on loss of blowing air — 4:00
5. Reset condensate-transfer system to and from hotwell for normal operation — 5:00
6. Open guard valves on condensate regulator to gland-seal tank — 5:05
7. Isue repair tag for maintenance to reverse spectacle flange plate in 2-in. tie line between condensate and soot-blowing airsystems, so that blank flange is installed in line — 4:10

Water removal is not a major problem since it is vaporized by heat from the tubes. In our operation, we use only the wall, high-temperature superheater and reheater long retractable blowers.

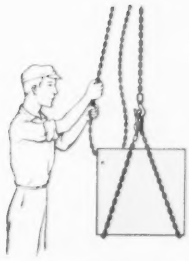
Scheme works out fine for us, but this doesn't stamp it for approved use on all boilers. Our unit is a 1,115,000-lb-per-hr job, completely water cooled. Its inner and outer casings are both of steel and are separated by a 3½-in.-thick strip of insulation. A refractory cement, laid over expanded wire mesh, fits between the wall tubes and the inner casing. Boiler's ashpit is a water-impounded type, has ash-removal sluice.

Caution should be the watchword before trying to water-wash your boilers. If the furnace contains exposed brickwork, or if the drum is located where it might be hit by the water stream, there's a chance of causing costly damage. Get the OK of your boiler and soot-blower equipment manufacturers before going ahead with some proposed water-washing scheme. But, if the shoe fits, you can chop a big chunk from your maintenance budget.

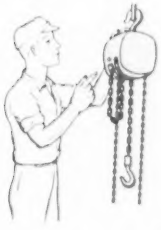
1 Proper size is important. Hoist capacity must at least equal load weight



2 Rig the chain block and load carefully. Never use the load chain as a sling



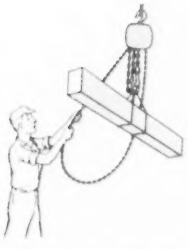
3 A metal sling carries the load safely. Never use rope to tie load to the hook



4 Tail-chain anchor pin must be free of defects. Inspect it before using hoist

5 Load brake must be in good operating condition, never slipping or dragging

6 An open load hook is dangerous. It may drop load. Replace it immediately



7 Stand aside. Never get under the load. Why ask for a crushed or broken head?

8 Handle all chain blocks carefully for good service. Never drop or throw them

9 Report defective chain blocks promptly. Never use one; it may drop the load

9 steps to chain-block safety

Sketches, above, illustrate some of the essentials of safe chain-block operation. If your men follow them, they will obtain maximum safety and keep chain block maintenance to a minimum.

Additional points to consider include the following: (1) Always suspend chain block from the saddle, not the tip, of the hook. (2) After hoist is suspended, check load chain for twisting or kinking. Never put a strain on a kinked chain. Take up the slack slowly and see that every link seats properly. (3) Never use the load chain for a sling. This can damage the load chain. (4) Use hoists of larger capacity than the regular work requires. (5) Tag each sling to indicate the maximum load it can lift safely. Remember, increasing the angle between legs of a chain sling and the vertical increases the strain on the sling.

Follow manufacturer's instructions for maintenance and repair. Inspect all parts periodically. Replace worn, corroded or damaged parts. Inspect upper and lower load hooks. Replace if they are distorted, opened, elongated in shank, or damaged in any way.

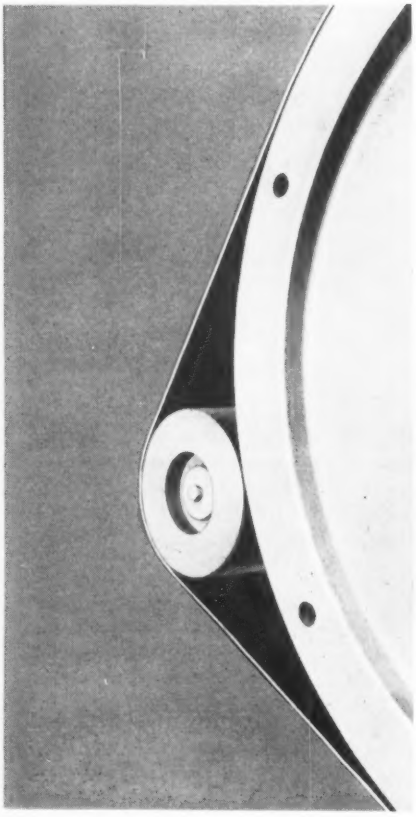
Inspect load chain with a magnifying glass. Replace if worn, corroded or damaged. Look for bent links, cracks, scores or markings, corrosion pits, lifted fins. Lubricate unit as recommended by manufacturer.

—Courtesy, Manning, Maxwell & Moore, Inc

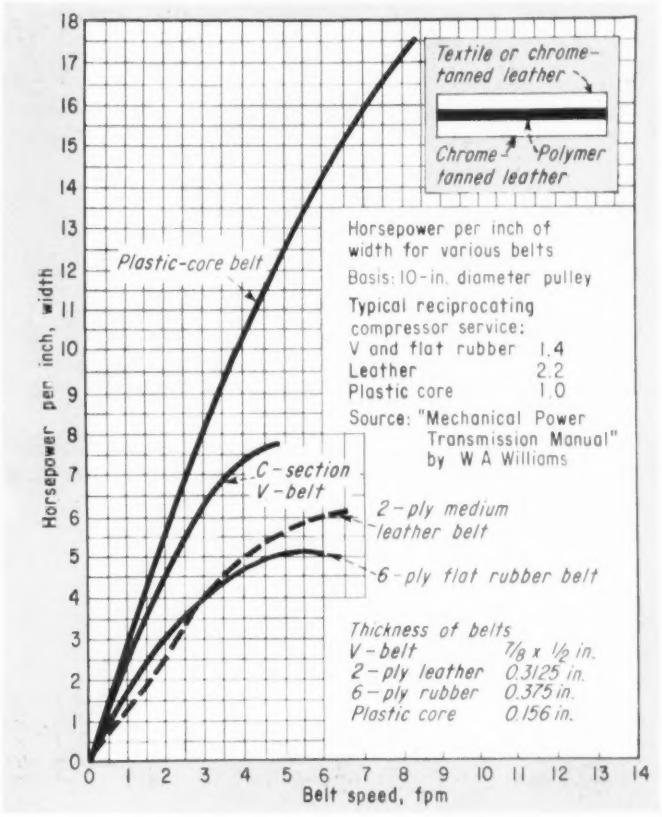
OPERATORS' NOTEBOOK **118**

Let's take a look at

Here's what you should know

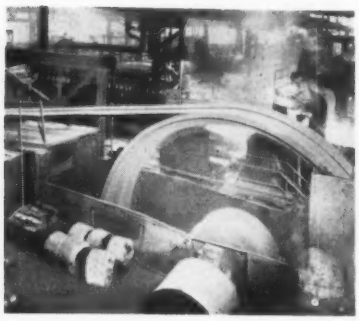


CLOSE CENTERS, with pulleys almost touching, are no problem for this tough new plastic belt



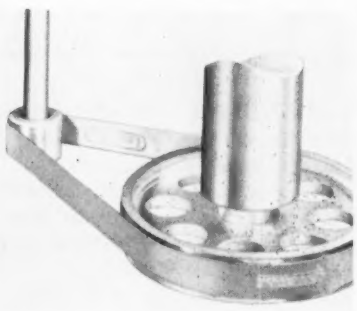
POLYMER, plus chrome-tanned leather, adds up to strength, elasticity, high friction and flexibility. Breaking strain of load-carry capacity ply is 28,500 psi

And here are some applications



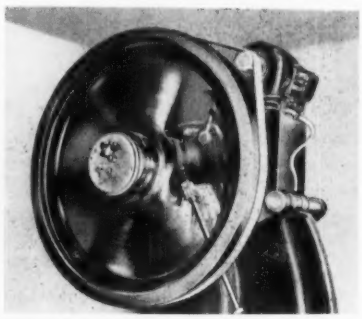
High capacity...

new rolling-mill drive with peak loads of 6000 hp, uses plastic-core belt instead of reduction gear to cope with shock loads



High speeds...

of 10,000 fpm on classifier drives up to 40 hp, call for plastic belt where other belts have failed. Belt runs at 24,000 fpm



High ratio...

of 20:1, with pulleys almost touching, are handled by plastic belt. Arcs of contact as low as 90 degrees do away with idlers

plastic-core leather belting

By STEVE ELONKA, Associate Editor

Industry is taking a long, hard look at a new plastic-core power-transmission belt claimed to eliminate stretch and run on fixed centers for years without adjustment.

Extreme strength of a polymer section results in a very thin belt that runs at much greater speeds than other types and operates around smaller pulleys. Compact drives that once were considered impossible, now become routine.

Friction properties of the running surface eliminate slip and reduce bearing loads, even at much higher pulley ratios. Biggest savings come from years of trouble-free operation, resulting in less maintenance and downtime.

Belt consists of a polymer tensile member, sandwiched between a chrome-tanned-leather friction surface; chrome-tanned leather has the highest coefficient of friction of any practical belting material.

Unlike other belts, the leather serves only as a friction surface. The load-carrying job is left to the plastic center. Because the leather carries no load, it can be tanned for maximum coefficient of friction, without regard to strength or stretch properties.

This combination provides a belt that's strong, elastic and flexible. It absorbs shock loads and won't take a permanent stretch. Also, the belt outpulls any other type of belt at lower bearing loads.

Most common type of this new belt has layers of leather and textile, with polymer sandwiched between. Two other types are for unusual drives. One, utilizing a layer of polymer and a layer of leather, is for ultra-high-speed drives needing a belt of great flexibility and light weight. The other special construction has two layers of leather over several layers of polymer. It's used on multi-pulley drives where the belt must drive off both sides. Eight variations of these constructions are possible. They provide a 7:1 range in tensile member thickness (from 0.02 to 0.14 in.), in steps to adapt to any drive.

Why plastic belt reduces bearing load . . .

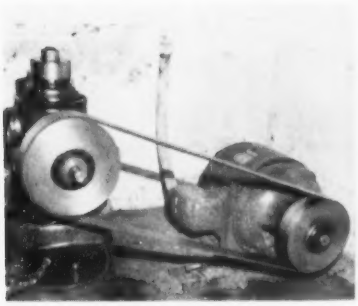
Tensional or bearing load, required to transmit power through belts, depends on three factors: (1) belt pressure against pulley (2) friction coefficient of running surfaces (3) theoretical minimum belt pull to transmit the horsepower.

Factor (1) depends on belt's ability to maintain a constant tension or pressure against the pulley. Plastic belt won't stretch and needs no over-tightening to compensate for stretch. And, since it can be installed at the minimum required tension, it never imposes excessive loads on bearings. While plastic has no permanent stretch, it's elastic. Elasticity is very important, especially under shock loads and vibration.

Factor (2)—bearing load—depends on the coefficient of friction of the belt's surface. The higher the coefficient of friction, the lower the bearing load needed to resist belt slip.

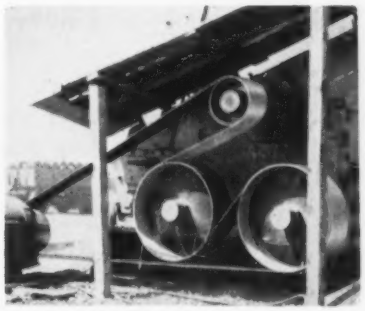
Factor (3) involves utilizing high-speed capabilities of plastic-core belting. When belt speed doubles, pull needed to transmit same horsepower is cut in half. Since optimum operating speed is 14,000 fpm, the belt pull often can be reduced to a fraction of its original value by increasing belt speed. Because plastic belt is much narrower, you can use narrower pulleys and keep center of pull closer to the bearings. This feature permits the design of more compact equipment, taking less space.

—*Courtesy, Extremultus, Inc, New York, N. Y.*



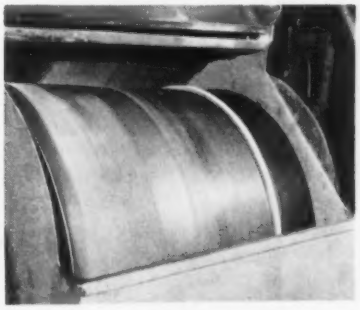
Low bearing loads . . .

hot bearings and short belt life led to replacement of six belts on this drive with this plastic belt sized only half as wide



Shock loads . . .

are no problem for plastic belt as its elasticity absorbs jarring vibrations, eliminating equipment damage and power losses



Cone pulleys . . .

use plastic belt of only a fraction of former belt's size. Narrower width solves both draw and speed-regulation headaches

MICROPHOTOGRAPH shows copper embedded in face of the carbon brush. Some metal transfer is needed for good commutation

By G H GUNNOE Jr, Senior Application Engineer
General Electric Company

WHEN CARBON-BRUSH LIFE IS CUT SHORT AND COMMUTATION PROBLEMS CROP UP, THE FINGER OF GUILT OFTEN IS THRUST AT THE BRUSHES THEMSELVES. BUT, OUTSIDE CONDITIONS MAY BE THE REAL CULPRITS. SO LET'S FIND OUT . . .

Poor working conditions

Brush troubles begin when operating conditions falter. To operate correctly, there must be some metal transfer resulting in good commutation. Transfer of metal from the collector surface, plus its oxidation, helps to form necessary commutator film. This film acts as a lubricant, aiding sliding action between brush and copper.

Excessive transfer, however, creates a tough problem. It decreases operating efficiency of a machine by reducing brush commutating action. At the same time, it increases brush friction, brush selective action and brush and commutator wear.

Burned brush shunts, excessive chatter, copper deposits on insulated surfaces, a raw streaked commutator and visible metal on brush faces, all indicate that the metal-transfer rate is too fast.

A little probing may turn up the cause of excessive

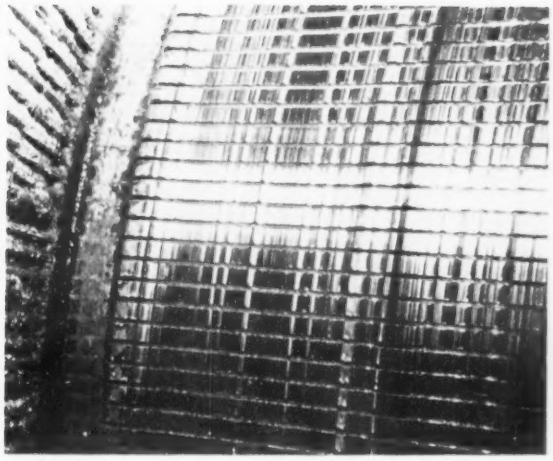
Are you demanding too much, or too

Carbon brushes are a necessary evil, creating problems that we're forced to live with. When discussing brushes, the natural tendency is to make the prevention and cure of brush troubles the main topic, (as evidenced by the text above). Now, let's balance the picture and find out what the ingredients of good carbon-brush performance actually are.

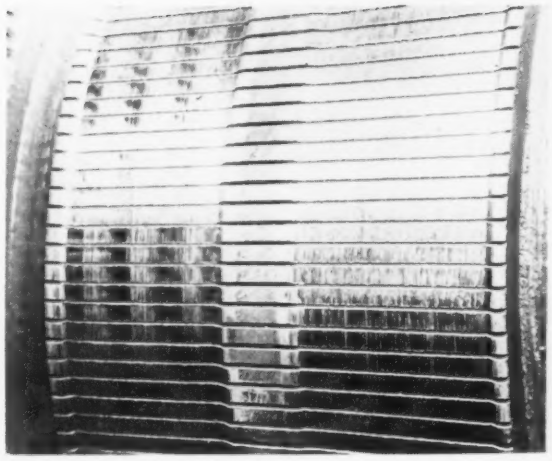
Brushes must conduct current with a low voltage drop. And, they must live up to three basic performance standards: (1) Brushes must give good life. (2) They can't mar commutator or collector rings. (3) They can't cause *destructive* sparking.

Setting up standards is difficult. Because of the many operating variables you rarely get all three factors at one time. First, take a hard look at your machine. High-speed units eat up brushes faster than their slower-running counterparts, but the correlation between brush life and machine speed is often unpredictable. Further, a new machine is harder on brushes than older units—as the commutator takes on a polish, brush wear should improve.

Sometimes brushes don't appear to last too long on older machines. But, before blaming the brushes, eye your commutator. Is it rough? Has sparking developed? What about the surrounding air — is it dustier than



THREADING is deep scoring of the commutator. Metal builds up on brush face, hardens, forms cutting tool, scores commutator



GROOVING is fine brush-width scoring of commutator surface. Too much abrasive, from brush material, acts as a grinding stone

are the main cause of brush trouble

transfer. Make sure that machine's electrical-neutral adjustment is OK. If machine is carrying a light load, check for copper building up on the brush faces. Make sure there's sufficient current flow to vaporize or burn off metal as it collects on brushes. Excessive sparking can also speed transfer rate, as can contamination (even though slight). Your brush pressure might be too light or you might be using the wrong brush.

Microscopic examination of transferred metal often dictates a change in brush grade. But, scarcity of trained men limits the usefulness of the miscroscopic inspection technique.

Threading often follows on the heels of fast metal transfer. Metal, building up on brush faces, soon work hardens and forms a cutting tool that scores the commutator. Poor atmosphere and light machine loading—conditions of excessive metal transfer—also cause threading. Porous carbon brushes provide good anchoring points for copper transfer and are prone to threading.

Threading can be prevented by removing some brushes, thus increasing density and burning off excess metal. An increase in brush pressure can up the wear rate and flake off copper with the carbon. You can also cut down on threading by keeping ambient air clean to reduce contamination. And, by experimenting with different materials, you may be able to minimize contact points and metal adherence to the brush face.

Grooving is a mechanical condition caused by abrasive materials in the brush carbon. Although not as serious a problem as threading, it can still cause trouble. To eliminate grooving, change over to carbon brushes having a minimum of hard materials in their makeup.

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little, from your carbon brushes?

usual? These conditions are hard to spot, yet all will shorten brush life.

Brush material is an important consideration. Brushes of high strength and low resistivity last longer than those having low strength and high resistivity. The thing to watch is how fast the brush wears or marks the collector ring or commutator surface. If there's no threading or grooving, performance is satisfactory. Even if commutator film is streaked, the situation may not be bad. During commutation, the surface at the brush face changes constantly, affecting the commutator film.

Commutator color is often criticized. However, if brush performance has been satisfactory, commutator color is of minor concern. Visible sparking is OK if there is no marking or rapid wear. So, before you condemn your brushes, consider wear, sparking and commutator marking. The sub-par service that worries you might actually be up to standard.

Your maintenance men can prevent much of the grief connected with carbon-brush disorder. By knowing the symptoms and cures of brush ills, they can slash your carbon-brush problems to the minimum.

In the concluding article we'll discuss the problems of commutator bar marking, copper drag and effective commutation—in an upcoming issue.

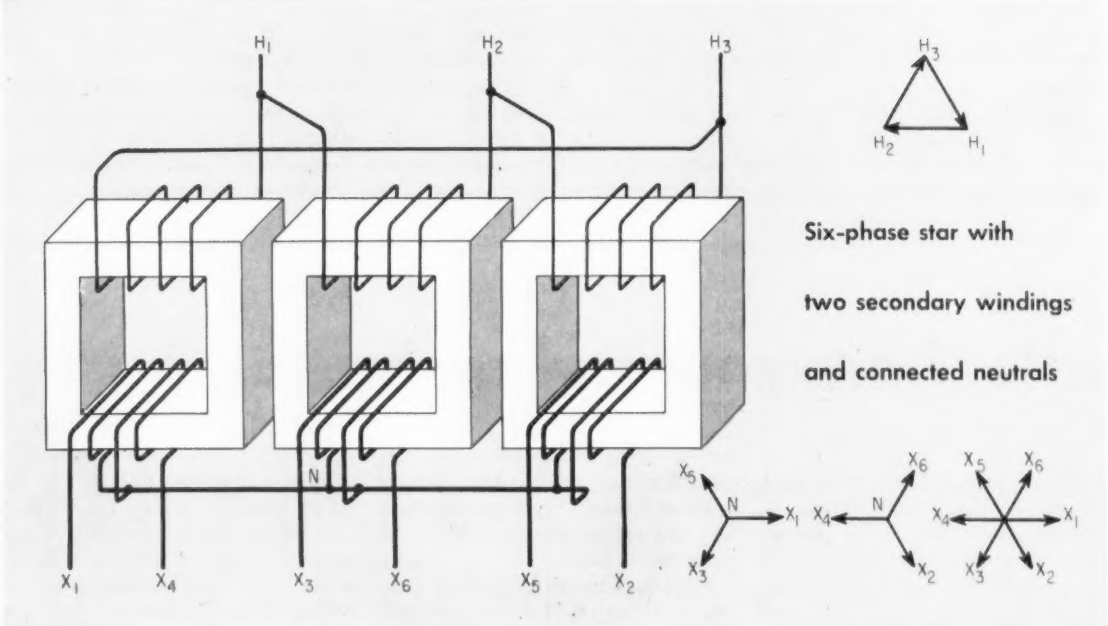
Plant Electrical Fact File

NO. 25: SIX-PHASE TRANSFORMERS

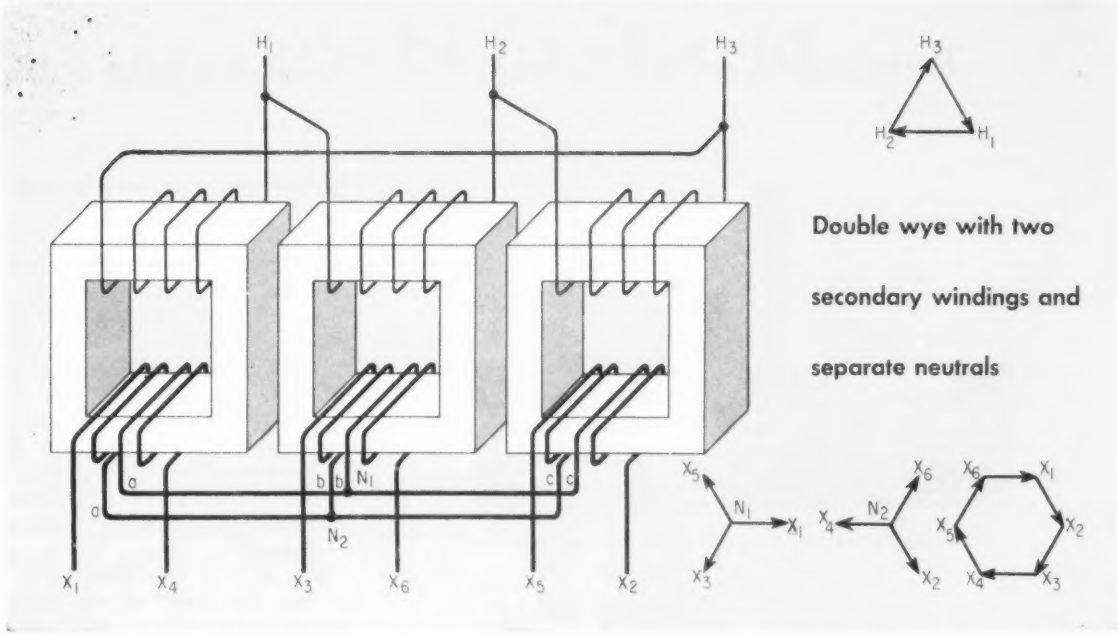
Six-phase alternating current is used for conversion to direct current by large power rectifiers, as explained in *Plant Electrical Fact File* No. 14, May 1957. Using transformers with two secondary windings, two single-phase outputs are obtained for each phase of the 3-phase input. The two windings can be connected opposite to each other; that is, 180 degrees out of phase. Thus, six output voltages are available, each 60 degrees out of phase with its adjacent phases. Three types of 6-phase connections are in use. The windings of rotary converters are connected in the same manner as 6-phase transformers. Rotary converters are not being installed today, but many are still in use in older plants requiring direct current.

By NORMAN PEACH, Assistant Editor

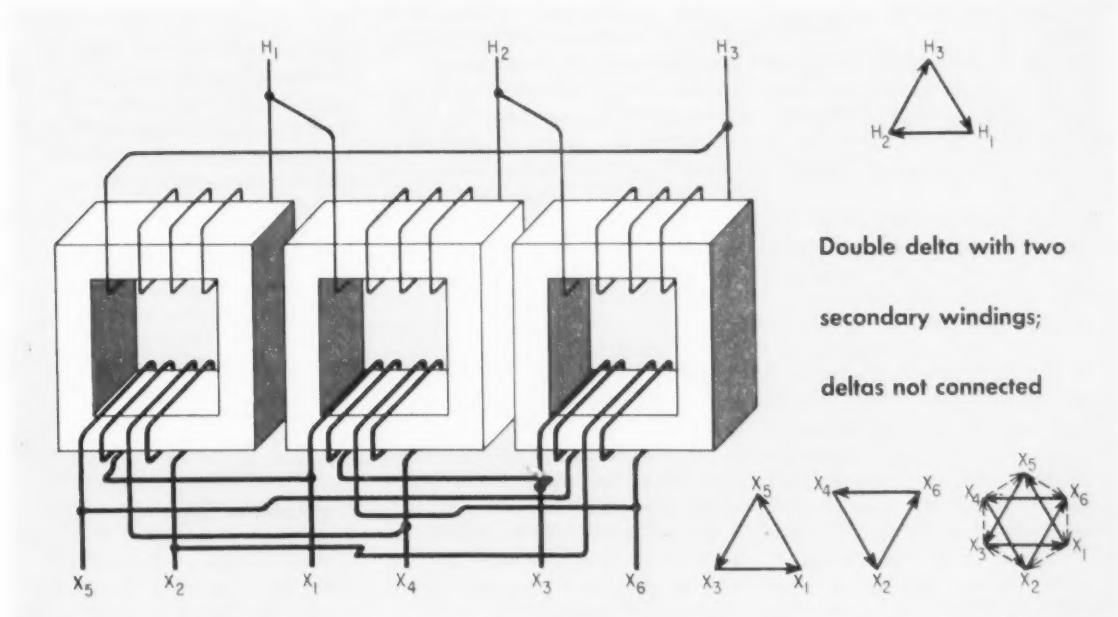
These transformers change 3-phase to 6-phase current



SIX-PHASE STAR has both secondary windings connected into separate wyes. The neutrals of the wyes are then connected together, leaving 6-phase leads. The primaries are shown connected in delta, but they can also be connected in wye. Secondary voltages, indicated by the vectors at the right, combine to give the 6-phase voltages shown by the last vector. Six-phase stars have two major advantages: (1) They have neutral for use as a ground or return in a 3-wire system. (2) They give 6-phase voltage without need for a load connected to terminals.

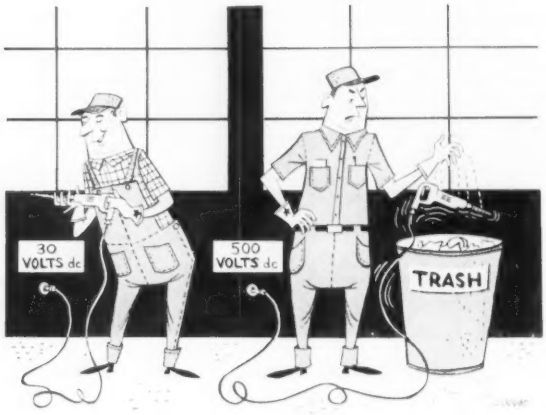


DOUBLE-WYE AND DIAMETRAL connections require a load to be connected in order to produce 6-phase voltages. Double-wye connection omits tie between the neutrals N_1 and N_2, produces voltage relationship shown by the lowest vector. Diametral connection omits neutral altogether, can use single secondaries connected at *a-a*, *b-b*, *c-c*. Voltage relationship is the same as for 6-phase star as long as load is connected. Diametral connections are often used on rotary converters because single-winding secondary simplifies coil connections in the machines.



DOUBLE-DELTA connections have two secondaries connected into independent deltas, as shown. This connection requires a load in order to produce 6-phase voltage. Voltage relationship between output leads is shown by the last vector in diagram. Unlike the double-wye and star connections (where voltage between leads is equal to that of one of the transformer secondaries), voltage between load points, shown by dotted vectors, is 0.577 times voltage across one secondary coil. Preference for double-delta connection depends on harmonic voltages.

Timely **practical ideas** to help solve



My *favorite gripe*... Why don't we have proper insulation values for appliances?

Today, almost every type of plant condition is covered by a code of some sort. Compliance with these is usually voluntary. In some cases it's mandatory since goods are built, installed and serviced by regulations so set up.

But there's no code for resistance value of electrical appliances. Lack of a standard or code is probably cause for some obvious discrepancies that come up in testing insulation resistance.

We all know that insulation resistance between windings and metal frame of portable electric tools and appliances varies with temperatures, humidity, cleanliness, size of motor, etc. Further, measured value of insulation varies with sensitivity of measuring instrument.

For example, a ¼-in. portable electric drill, which had been in service for several years, was tested under various conditions. Its insulation resistance measured 35,000,000 ohms at 30-volts dc, 1,300,000 ohms at 250-volts dc, and 810,000 ohms at 500-volts dc. After cleaning and drying, same drill measured 40,000,000 ohms at 30-volts dc, 4,500,000 ohms at 250-volts dc, and 3,330,000 ohms at 500-volts dc.

From this, you can see that test results obtained in various shops aren't always comparable with each other. That causes arguments among electricians responsible for tests. It's clear that the maintenance man relying on a 30-v ohmmeter will get optimistic results, while another using a 500-dc instrument will be rejecting tools that are safe to operate.

Now, 100- to 500-v dc is usual voltage used for testing electrical equipment. I have consulted with small portable tool manufacturers and service shops. After some research and checking standard publications, I find it's best to standardize with a test voltage of 250-v dc, and minimum insulation resistance of 300,000 ohms.

Selecting 250 v gives a voltage that's OK for testing 115-v tools. And it's less apt to puncture insulation. Minimum value of insulation resistance of 300,000 ohms allowed at this test voltage is presumed high enough and won't impose too high a standard to maintain. Also, 300,000 ohms will limit leakage current on ungrounded tools to a safe value below the perception point of the average tool operator.

Minimum value of insulation resistance of 300,000 ohms at 250-volts dc and the applied potential can be changed to suit individual standards. So, what are we going to do about it?

P C ZIEMKE, *Clinton, Tenn.*

Boiler low-pressure alarm

Our 600-psi boiler didn't have a low-pressure alarm. Only time low pressure on boiler was noted was if operator happened to spot it. If not, boiler pressure would drop until steam pressure to condenser air-ejector would fail to work. Then vacuum on turbine would drop to 25 in. and sound a low-vacuum alarm. But boiler pressure would drop to 450-psi before alarm sounded. Our boiler controls are all automatic.

High-pressure alarms are rather expensive, so I installed a mercoid control, 0 to 14-psi, in the master-control outlet. I set control to ring at 8½ in. mercury and clear at 7½ in. mercury. This corresponds to boiler pressure drop of about 25 psi. Alarm circuit was tied into existing annunciator system and marked for excess boiler loading pressure. At most loads, boiler master loading never exceeds 7 in. mercury. Master control has output of 10 in. mercury.

This alarm warns operator of trouble almost immediately and machine doesn't lose vacuum or load. We are tied in to a large system and load on the turbine could be lost without any frequency change.

Master-control output line was cut and a tie installed, then mercoid control and stop valve were added. Total cost of installation was about $35.00. This alarm has been in service for about two years with excellent results. Boiler is 175,000 lb per hr, turbine 15,000 kw. Plant is single boiler and turbine unit.

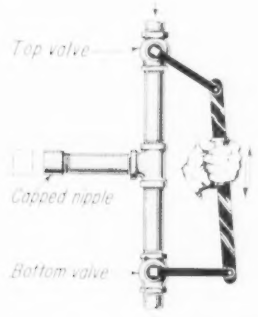
C J WERDERITCH, *Clinton, Iowa*

Now is the time...

to start thinking about spring floods. With heavy snows this past winter, the spring thaw will bring tons of water down upon many plants. You alert plant engineers can do many things to prevent low machinery rooms from being flooded. See POWER, April 1958, pp 109-115 for a timely report on combating floods.

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor



Sure-fire measuring device

Device shown was built to dispense a measured amount of liquid into a process tank. This liquid feeds from an overhead tank. A little liquid is added to each batch mixed in the process tank. This rig has two lever handle cocks, arranged as shown.

Pipeline between the cocks has a volumetric capacity equal to the amount of liquid to be dispensed. Volume can be adjusted by changing the length of the capped nipple screwed into the tee.

To dispense one measure, the handle is lifted. This closes the top valve and opens the bottom one. To refill the measuring pipe, the handle is pulled down again. The pipe should be large enough to allow air to bubble in as the liquid runs out. Air bubbles up through the line as the measuring pipe is refilled.

H KOSLOW, *Bronx, N. Y.*

Safety-first signs

Every plant should have several dozen "Men working" signs. Make them of fire-resistant fiberboard or any of the fire-resistant plastics. Ours are circular, 6- and 12-in. diameters. They have holes for wire clips or hooks to make hanging easy.

Paint both sides red, with white letters. We use the small ones for all valves, large ones for all openings. Always keep them clean and use on all connecting valves, manholes, drains etc. Make sure your men get into the habit of using them.

C C HOWARTER, *Canton, Ill.*

Here's a *de-blubberizing* menu for you swivel-chair engineers

Monday

Breakfast: Weak tea
Lunch: One bouillon cube in one-half cup diluted water
Dinner: One pigeon thigh; three ounces of prune juice (gargle only)

Tuesday

Breakfast: Scraped crumbs from burnt toast
Lunch: One doughnut hole (without sugar)
One glass of dehydrated water
Dinner: Three grains cornmeal, broiled

Wednesday

Breakfast: Shredded egg shell skin
Lunch: One-half dozen poppy seeds
Dinner: Bee's knees and mosquito's knuckles, sauteed in vinegar

Thursday

Breakfast: Boiled-out stains of old tablecloth
Lunch: Bellybutton of a navel orange
Dinner: Three eyes from Irish potato (diced)

Friday

Breakfast: Two lobster antennas
Lunch: One tail joint of sea horse
Dinner: Rotisserie broiled guppy fillet

Saturday

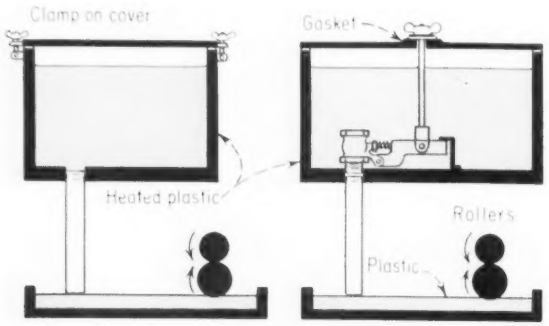
Breakfast: Four chopped banana seeds
Lunch: Broiled butterfly liver
Dinner: Jelly vertebra a la centipede

Sunday

Breakfast: Pickled hummingbird tongue
Lunch: Prime rib of tadpole; aroma of empty custard pie plate
Dinner: Tossed paprika and clover leaf salad

NOTE: A seven-ounce glass of steam may be consumed on alternate days to give you something to blow off

Turn page for more Practical Ideas ►



Here's a foolproof feeder

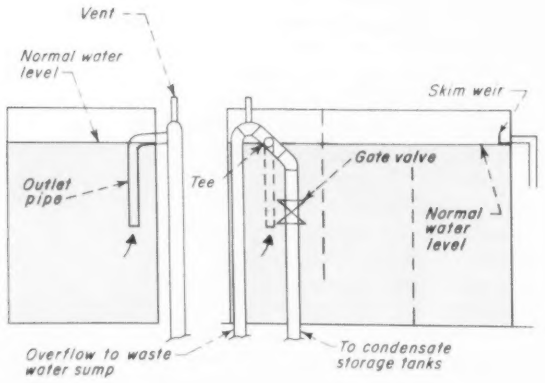
We have a machine for applying a coating of hot plastic to sheets of cloth. Cloth is passed through a set of rollers. Lower roller dips into a tank of plastic. Heated reservoir above this tank stores molten plastic, first sketch.

Because of air lock in this tank, plastic was fed at same rate as used. Feed worked well and maintained a constant level, which fed the rollers. But it had one fault: occasionally a workman would, because of ignorance or sometimes as a practical joke, open the cover on the supply tank. This would allow all of the plastic to run down into the lower tank, flooding it.

To remedy this, we rebuilt the tank, second sketch. We added a lever-operated sliding-stem valve. We installed a rod up through the cover and threaded it to take a wing nut. Then, a compression spring was added to the valve stem as shown.

Now, the plastic is added to this supply tank and the cover put in place; then a wing nut is added and tightened. Only after it's tight enough to compress the spring does the valve open. Thus the valve never opens until the cover is tightly seated. A stop prevents overtravel. This rig has stopped accidents and horse play.

E JONES, *Bronx, N. Y.*

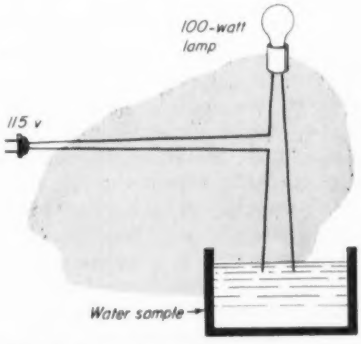


Tank separates oil from fuel-oil heaters' condensate

We installed skim tanks in a number of oil-burning plants. Tanks are divided into three compartments. Condensate enters and is released near the bottom of first compartment, sketch. With heavy residue oils having specific gravity over 1000, oil in condensate settles to bottom of tank in black globules resembling marbles. Lighter fractions float to water surface in tank. Three compartments allow longer rest period for oil to separate from condensate.

Skim weir permits stripping oil from condensate surface. Crest of weir is higher than tank outlet, but lower than overflow. By closing valve in outlet pipe, and opening valve in outlet from skim weir, condensate may be discharged over skim weir until floating oil film is eliminated. Overflow is to prevent tank from spilling over top in case line to condensate storage tanks is closed.

H T LIVINGSTON, *Los Angeles, Calif.*



Try this quick way to test dissolved solids

This idea probably goes back to Columbus' era, but here's a practical adaptation. We use it for a quick, cheap way to test dissolved solids in our evaporator water.

Sample of water is held so wires are immersed. Distance between prongs is set by trial and error to make circuit when dissolved solids are at 2500 ppm. When a sample of water is held under the prongs and the light goes on, we know we have 2500-ppm dissolved solids. Then we increase blowdown.

S H KRONE, *Jamestown, N. D.*

Turn page for more Practical Ideas ▶

What made Thief River Falls decide on STANDARD D&G Oil

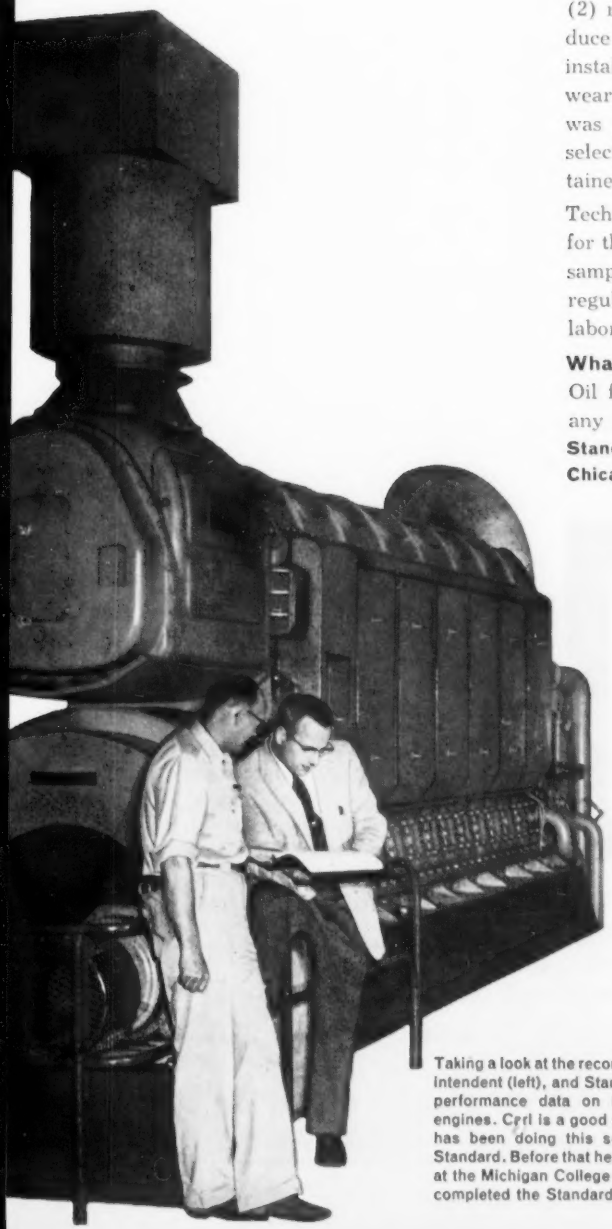
Two Fairbanks-Morse OP engines turn in top-rated performances with this lubricant.

The situation: In January of 1952 the Thief River Falls, Minnesota, municipal light plant put into service a 10-cylinder, 1,600 hp. Fairbanks-Morse opposed piston engine. In November, 1955, a 1,900 hp. Fairbanks-Morse OP engine was added.

What was done: The power plant management discussed lubrication requirements with Standard Oil lubrication specialists. Because of the evidence that STANDARD D&G Oil, with its higher additive level, could (1) reduce ring and wall wear, (2) reduce ring sticking, (3) increase bearing life and (4) reduce engine deposits, this oil was selected for the first engine installed. After 22,000 hours, inspection showed little or no wear. Small wonder then that when the second OP engine was put into service in 1955, STANDARD D&G Oil was again selected. After 7,500 hours, similar performance is being obtained on the newer engine.

Technical service performed by Standard Oil men pays off for the power plant management. Standard men take frequent samples for field inspection of oil condition. Other samples are regularly taken for transmittal to Standard's Whiting, Indiana, laboratory for complete analysis.

What you can do: Get more facts about STANDARD D&G Oil from the Standard Oil lubrication specialist near you in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.**



Taking a look at the record. Morris L. Owen, plant superintendent (left), and Standard Oil's Carl Klenner look at performance data on the two Fairbanks-Morse OP engines. Carl is a good one to talk things over with. He has been doing this sort of work for 10 years with Standard. Before that he received an engineering degree at the Michigan College of Mining and Technology and completed the Standard Oil Sales Engineering School.

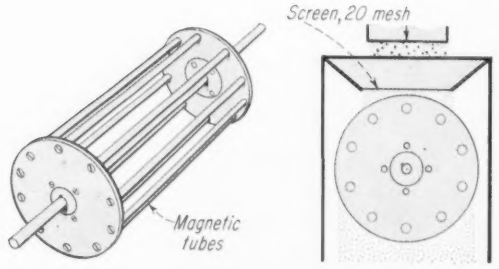
Quick facts about STANDARD D&G Oil

- Made from highest-quality solvent-refined stock.
- Contains additives which impart superior detergent-dispersant and anticorrosion properties.
- Antifoaming.
- Oxidation-resistant.
- Recommended for use (1) with economy fuels (2) in extreme-load and/or low-temperature service.

You expect more from STANDARD *and get it!*

More **practical ideas**

Begins on page 122



Now, magnets prevent explosion in food process plant

Candy making has its explosion hazards because of dust from confectionery sugar, corn starch, flour and cocoanut grindings. Processes are all confined in ducts and tubes where transport is by various means. But very fact of this confinement can produce some hefty explosions when correct mixtures of dust and air come in contact with sparks.

Many of these sparks are caused by static electricity which is prone to develop under certain ideal conditions common to dust propagation and handling. But our problem was iron particles in the grind.

Roasted cocoa beans were ground in five stages; the final stage being comparable to paint grinding, or grinding between two closely fitted rollers. Any ferrous metal, though ever so minute, can raise hob when brought into such close tolerances in the explosive dust-air mixture.

To extract the miniature tramp iron seemed simple enough since boiler plant men had been cleaning iron out of the coal stream ahead of the Raymond mills for years. Only, in this case, the collector rings, brushes, etc to convey the dc current had to be enclosed in explosionproof structures. That meant heavy costs, out of proportion with protection gained.

Answer was to use natural magnets that required no power supply nor expensive explosionproof enclosures. Flow line was cut for the insertion of a screen and rotor-grate type of revolving magnets turning at 30 rpm through a shaft and single V-belt drive arrangement. Cleanout door was equipped with an electrical interlock to prevent injury to operator engaged in removing the trapped iron. At first, the scrap was wiped off with the gloved hand and deposited on a pan held over the lower extension of duct. Now, a vacuum connection does the job much better.

Cleaning operation is performed at noon and at cleanup time at end of shift. Removable screen ahead of the rotor-grade needs but one cleaning per stage. This setup works fine for us.

P C ZIEMKE, *Clinton, Tenn.*

My way is simpler

In POWER, Oct 1957, p 129, C Bachmann tells how he charged a refrigeration compressor crankcase by putting oil in an empty cylinder, then applying Freon pressure from a separate drum of refrigerant. This was done at the seasonal start-up. The oil shortage was presumably the only thing wrong with the system. He chose this way to introduce the oil because he had no auxiliary oil pump.

Much simpler way is to attach a length of ¼-in. tubing to the suction service valve-gage connection. Connect a small valve in this ¼-in. line and let the far end of the line dip into a container of oil. Start the compressor and close the service valve. Then, a vacuum is pulled on the compressor crankcase. Thus, when the small valve in the oil charging line is opened, atmospheric pressure forces oil into the crankcase.

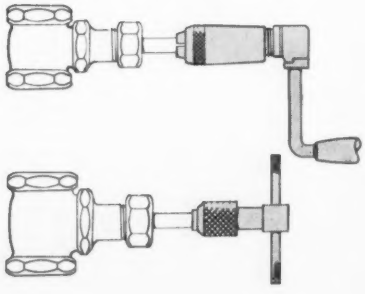
But oil should not be added until the system has operated for several hours. Starting up after a long shutdown churns the mixture of refrigerant and oil in the crankcase. Oil is forced past the piston rings and cannot return to the crankcase easily. Reason: the crankcase is usually at a higher pressure than suction pressure during start-up period. If the system was known to be short of oil, it was almost surely lacking refrigerant. Leak should have been repaired before oil or refrigerant was added.

D SULLIVAN, *Detroit, Mich.*

Do you know . . .

that many plants present a copy of *Plant Operators' Manual* to each operating employee? Over 1500 illustrations show how to do everything from setting valves to inspecting boilers. The book fits in nicely with training programs, too.

Handy valve openers for temporary repairs



We have a lot of process piping in our plant. With all these valves, the driving square on a stem often rounds off so we can't close a valve. We make a temporary repair until the line can be shut down. On small valves we use a tap wrench, bottom sketch; on larger valves, we use a brace, top sketch. We find these are much better than a wrench.

E JONES, *Bronx, N. Y.*

My biggest boner

Please turn to page 190

YOU CAN PICK A YARWAY IMPULSE JUST RIGHT FOR YOUR STEAM TRAP NEED

(wide choice of sizes, capacities, pressures and temperatures)

FOR NORMAL REQUIREMENTS

Medium pressures and temperatures—Series 60. Normal condensate loads, pressures 10 to 400 psi, temperatures to 450° F. Six sizes, ½" to 2".

HIGHER PRESSURES AND TEMPERATURES

Normal condensate loads—Series 120; pressures 10 to 600 psi, temperatures to 750° F. Six sizes, ½" to 2".

FOR LIGHT CONDENSATE LOADS

Medium pressures and temperatures—½" No. 20-A; pressures 10 to 400 psi, temperatures to 450° F.

Higher pressures and temperatures—½" No. 120-A (not shown); pressures 10 to 600 psi, temperatures to 750° F.

FOR HEAVY CONDENSATE LOADS

Low, medium and higher pressures and temperatures—Series 40 (lever type); pressures to 600 psi, temperatures to 750° F. Five sizes, ½" to 2½".

FOR POWER PLANT AND MARINE SERVICE

Integral-strainer trap. Normal capacities, pressures to 2500 psi. Six sizes, ½" to 2". Flanged or socket-weld ends.

Already more than 1,225,000 Yarway Impulse Steam Traps have been sold.

For your convenience—Yarway Traps and Strainers are carried in stock by over 270 industrial distributors all over the world. (Write us for name of the one nearest you.) Try some Yarways in *your* plant and begin to enjoy the improved trap performance many others are experiencing. Prompt steam trap engineering advice and service available to you from our own force of 34 field engineers.

For free booklet "The Why and How of Steam Trapping," write . . .

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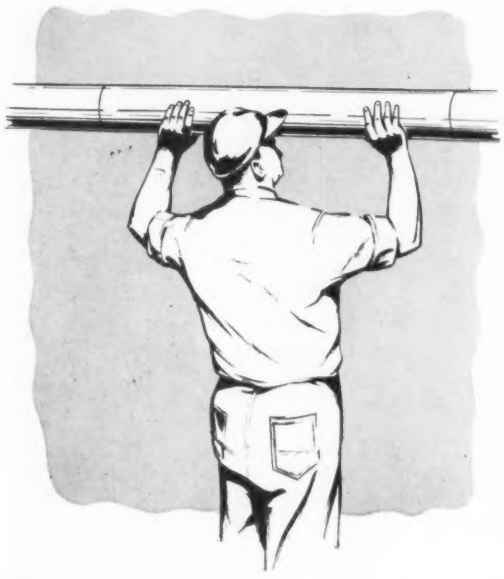
YARWAY *impulse*® *...a good way to specify steam traps*

These **plant problems** could well be yours...



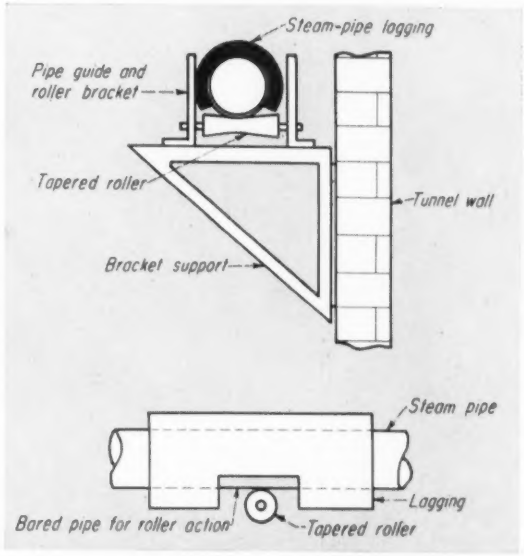
The problem

What's best way to support steam piping in tunnels?

We're engineering the heating system for a large apartment-house development that will be heated from a central heating plant. Consisting of nine multistory buildings, the development will cover almost 30 acres.

We're planning to run steam heating pipes in tunnels, radiating out from the heating plant. Because of the extensive nature of this network, we are interested in any economies that can be made. For one thing, we wonder about supporting the steam lines on the exterior of the pipe insulation, to minimize heat given off and to reduce line losses. This, we believe, will also simplify inspection and maintenance work in the tunnels. Have readers had experience with this type of installation?—*AHD, February* POWER

The solutions



Negligible support heat loss here

In answer to *AHD* I'd like to point out that line losses from radiation at supports is greatly overemphasized. Normally, tunnel piping is supported by wall brackets, see sketch above.

Because of the long lines, piping will have to be anchored at several points. Since stationary fixtures don't have to be inspected, anchorage joints can be completely lagged. But allowance must be made for thermal expansion of the piping. Rollers fastened to the brackets do a good job. Since expansion will only be three to four inches, radiation heat loss from bared section resting on rollers will be negligible.

J BAILLIE, *Toronto, Ontario, Canada*

Why not eliminate tunnels entirely?

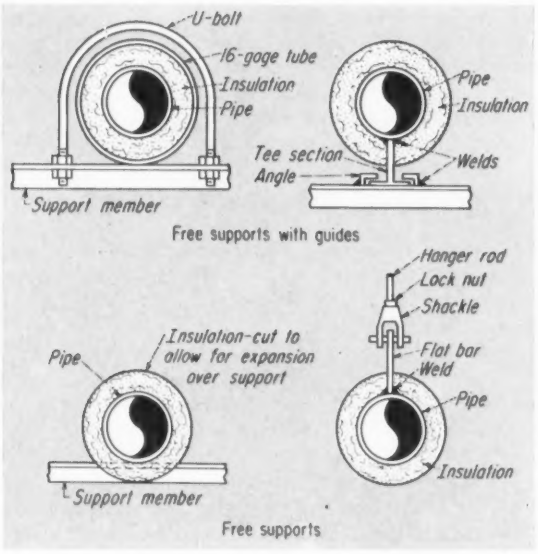
I'd like to ask *AHD* this question: If tunnels aren't needed for other purposes, why not use direct burial lines? They are economical and can be completely satisfactory. The lines are merely welded, insulated and covered to protect insulation by keeping out moisture.

Use of tunnels presents many problems. Shallow ones with covers give direct and easy access to the lines, but allow water and debris to enter. Shallow tunnels, sealed or covered with earth to keep water out, make inspection and maintenance difficult. Large tunnels eliminate both deficiencies, but are more expensive.

W HAMMER, *Japan*

...Here's how *Power* readers would tackle them

ROBERT MARKS, Assistant Editor



Four ways to support insulated pipe

Sketch, above, shows supports I have found useful. Each was selected after giving prime consideration to line stress. Heat loss at support points was neglected.

If it's not too late in the game, *AHD* should consider plain underground lines and do away with expensive tunnel construction. Dry, granular, bitumastic type compounds are manufactured specifically for underground insulation. This material is poured around the lines in the open ditch after pressure tests are completed. Ditch is then backfilled and steam applied to bond the granules to each other, forming a solid wall of insulation around the line. Such an underground piping system, properly installed, is virtually maintenance free.

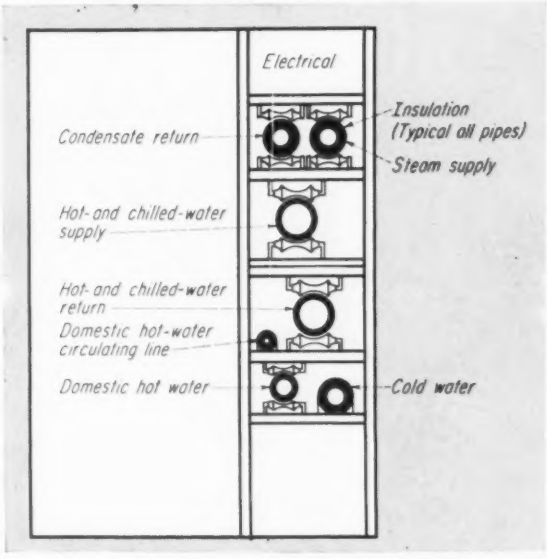
R THEISS, *San Jose, Calif.*

Insulation saddles are your best bet

It has been my experience that a support using an insulation saddle gives best results for the problem described by *AHD*. The pipe can slide when expanding, thus protecting the insulation. Heat losses because of the saddle touching the pipe are negligible.

A pipe covering protection saddle is another possibility if the load is not too heavy or a load bearing insulation is used. Pipe rolls can be used with either support, but I have found that they cease to roll after an interval of time in service.

E YUKNIS, *Chicago, Ill.*



Here's a typical steam piping tunnel

AHD is confronted with a project of considerable magnitude. His problem is one that certainly requires competent engineering design. Insulation must be provided to prevent transmission of heat from steam mains to water lines. In addition, care must be taken to control piping expansion and insure dependable trouble-free performance. Depending on his exact needs, the piping tunnel can be similar to that shown above or a circular cross section can be used.

W F RYAN, *Salina, Kan.*

Underground tile conduit has merit

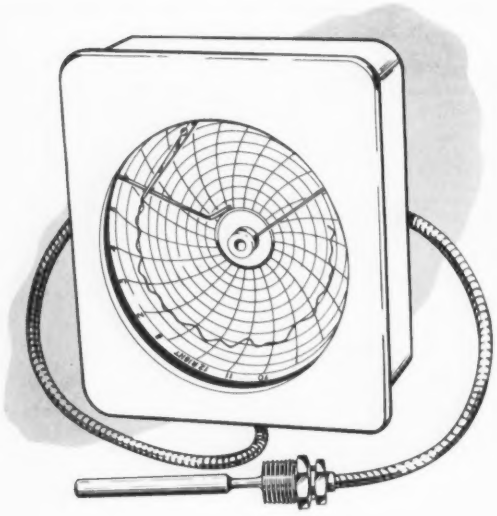
It is a moot question whether or not supporting pipe on insulation exterior will produce any economies. I suspect it will cost more than conventional hanging.

If economy is important, why not eliminate tunnels? Our 200-acre housing project has a central heating plant supplying steam for 140 residential buildings and a shopping center. The lines run about 2000 ft in an underground tile conduit system. Corrugated expansion joints are located in concrete pits at 500 ft intervals. In ten years we have had only one leak.

Large tunnels have many advantages too. They permit easy inspection, maintenance, and make future expansion and replacement simple. If we had tunnels our proposed rewiring job would be easier and less expensive.

W J STEINERT, *Fresh Meadows, N. Y.*

Turn page for info on temperature measuring ▶



The problem

Which temperature measuring elements should we use?

To keep closer tabs on operating conditions in our plant we're planning to add measuring instrumentation at a number of key points in our steam, condensate, fuel oil and cooling-water systems.

Our first thought was to use filled-system temperature bulb thermometers. But we're also considering possibility of bimetal as well as industrial liquid-in-glass thermometers. In some cases we'll be indicating; in others, recording. Our top temperature is 750 F. We'd like to hear experiences of POWER readers with temperature measuring instruments for the above applications.—*HCA, February* POWER

Want some help on plant problems? Send us any of your design and operating headaches. We'll put *Power* readers to work on them

The solutions

Try this 10-point selection guide

We find that thermocouples are best for severe temperatures. But their accuracy may not meet process demands for lower temperature ranges. We then use a filled system with pneumatic transmission to avoid long runs of easily damaged capillary tubing. On important points we also install a glass, industrial-type mercury thermometer for checking and emergency use. If temperature isn't critical, and is referred to only occasionally, we sometimes use the bimetal type.

The best instrument or control will not work in a poor location or if installed improperly. Often a laboratory-type thermometer with rubber stopper gives better results than an expensive recording unit unless someone takes pains to see that the right unit is selected and installed correctly. On any new job we use this 10-point quiz as a selection guide:

1. What is the operating temperature range?
2. What accuracy is needed—1, 5, 10 F?
3. How important is this temperature measurement?
   Class A—Variation causes damage or failure
   Class B—Variation causes inefficient operation
   Class C—Variation has little or no effect
4. What is the distance from point of measurement to location of temperature recorder or indicator?
5. Will instrument act as an alarm or control device?
6. Can this point be combined with others for multiple indicating or recording?
7. Is the measured substance (a) gas (b) steam (c) air (d) water (e) other liquid (f) special?
8. What metals are corroded by this substance?
9. Should response of measuring device be (a) fast (b) medium (c) slow?
10. Will the measuring device be located in (a) pipe (b) duct (c) air (d) other?

This quiz gives us enough data to select the instrument needed for any particular job. High accuracy over a small range usually calls for a vapor-tension instrument unless temperature is near ambient. Gas-filled systems then offer a solution. Mercury-filled designs are suited for narrow temperature spans calling for high-response speed and actuating power. Distance of instrument from measuring point is important. Avoid long runs of capillarly tubing. Lengths over 25 ft are too easily damaged.

Units with control or alarm functions are a separate problem. Selection depends on the process, type of final element and kind of control needed. Frequently, points can be grouped together on a multipoint recorder with a considerable saving in overall cost.

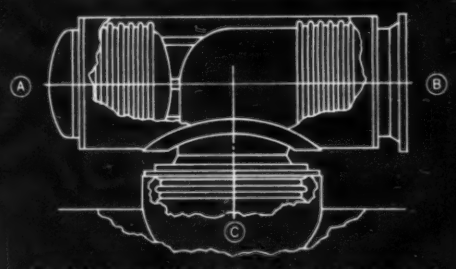
Materials used for the temperature bulb and socket depend on the substance measured. We prefer stainless steel on most applications since it usually gives the longest possible useful life. This is particularly important where the process can't be shut down at will to repair or inspect the socket. Location of the measuring element fixes bulb type and size.—C F BLACK, *Cleveland, Ohio*

For more on temperature and new problems, turn page ▶

GIANT Turbine Expansion Joints Built by BADGER

Photo shows 150,000 kw steam turbine-generator unit undergoing tests prior to shipment at General Electric's Turbine-Generator Plant in Schenectady, N. Y. Badger Expansion Assembly is clearly visible atop turbine.

Badger balanced elbow expansion assembly.



Joint A balances thrust due to internal pressure of 65-150 psi; joint B absorbs axial movement; joint C absorbs the differential expansion between the inner and outer casings of the turbine. Assemblies range in size from 36 to 42 inches in diameter.

Custom engineered assemblies include many features of Badger S-R Design

750°F steam is flashed through these turbine crossovers at speeds up to 150 ft/sec and pressures up to 150 psi.

How do you protect piping and turbine casings from the stresses of extreme internal pressure and the expansion such temperature is bound to produce?

Working together, Badger and engineers at General Electric's Large Steam Turbine-Generator Department solved the problem with a new type pressure balanced elbow expansion assembly. Using two separate joints mounted in a T-shape casing (see diagram) the assembly effectively absorbs and controls axial movement. Although the device was custom engineered to General Electric's requirements, the bellows elements are constructed to the Curvilinear Corrugation design recently announced by Badger and now used in all S-R Expansion Joints.

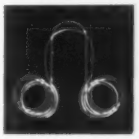
Whether you need standard S-R Expansion Joints or custom equipment, Badger can serve your needs. Get more information — write for illustrated brochure today.

New corrugation and ring designs produce better equalization, "all-curve" flexing

Curvilinear Corrugations used in S-R Expansion Joints were developed by the Badger Research Department. Under operating pressures (white line) the new design produces more uniform movement per corrugation and natural "all-curve" flexing. Stress is reduced . . . life increased.

Series 50 corrugation cross-section

S-R Joints for higher pressures have tubular Reinforcing Rings. These new rings make metal-to-metal contact only in the "valley" of each corrugation allowing natural "all-curve" flexing (white line). Tubular shape permits greater effective flexing height which contributes to longer life.



Series 150 corrugation and ring cross-section

BADGER

S-R

SERVICE RATED

EXPANSION JOINTS

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More **plant problems**

Begins on page 128

Type of instrument	*Temperature range, F*
Liquid-in-glass thermometer	–40 to 1000
Bimetallic thermometer	–100 to 1000
Pressure-spring thermometers	
Liquid filled (mercury)	–40 to 1000
Gas filled	–200 to 800
Vapor pressure	–50 to 600
Thermocouple pyrometers	
Copper-constantan thermocouple	–300 to 600
Chromel-constantan thermocouple	1000 to 2000
Iron-constantan thermocouple	0 to 1400
Chromel-alumumel thermocouple	1000 to 2000
Platinum-platinum rhodium thermocouple	0 to 2800
Resistance thermometers	
Copper	–40 to 250
Nickel	–300 to 600
Platinum	–300 to 1200
Optical pyrometer	1000 to 5000
Radiation pyrometer	200 to 3500

Start with a temperature range table

Table, above, gives temperature ranges for various measuring instruments. But these values may be extended for some jobs. In the case of thermocouples the price is decreased life at higher temperatures. To partially offset this, they must be protected adequately, use larger wires and be located in the right atmosphere.

Liquid glass thermometers are limited to local indication. Pressure-spring thermometers are based on the principle that pressure component in a constant volume system is a function of temperature. A large sensing element or bulb is connected by capillary tube to a pressure gage calibrated for temperature. System is filled with a liquid, gas or vaporizing liquid and is a reliable way to indicate, record or control temperature. It's possible to locate gages as far as 200 ft away from sensing elements.

Thermocouples use two dissimilar metals joined at the ends. Heating one junction causes emf generation. Resulting voltage is proportional to temperature difference between junctions. Temperature measured is at the small junction between metals. Any change in line resistance can lead to inaccuracy.

Resistance thermometers offer greatest accuracy. Sensing-element resistance varies with temperature and is measured by a wheatstone bridge. Elements must be protected to avoid mechanical damage or contamination. Unlike thermocouples, resistance thermometers measure average temperature of sensing element.

Optical and radiation pyrometers don't require contact with an object to measure its temperature. So they are used where temperatures exceed limits of other types. Optical pyrometer has greater accuracy.

Ultimate instrument selection depends on (1) the accuracy needed (2) the temperature range (3) the expected life (4) the type of measurement and (5) the cost.

H B Wayne, *Woodhaven, N. Y.*

Trouble-free operation is important

Filled system thermometers are accurate, comparatively inexpensive and will give long periods of trouble-free operation when used properly.

Only possible disadvantage is that the instrument must be rather close to the point at which temperature is measured. Actual distance depends on the length of tubing that connects the instrument to its sensing element.

If a remote reading instrument is desired, then an electrically operated instrument should be installed. For extremely accurate readings or control, the higher cost of an electrically operated unit may be justified. But this seems doubtful in *HCA's* case.

L E Polikoff, *Bethpage, N. Y.*

Your May problems

How can we revive our sick wells?

I'm plant engineer for a medium-sized manufacturing outfit. Several years ago we put in an air-conditioning system and had to drill new wells for cooling and general plant service. Ground-water supply is adequate, but local regulations make it mandatory to return to the ground all water drawn from it.

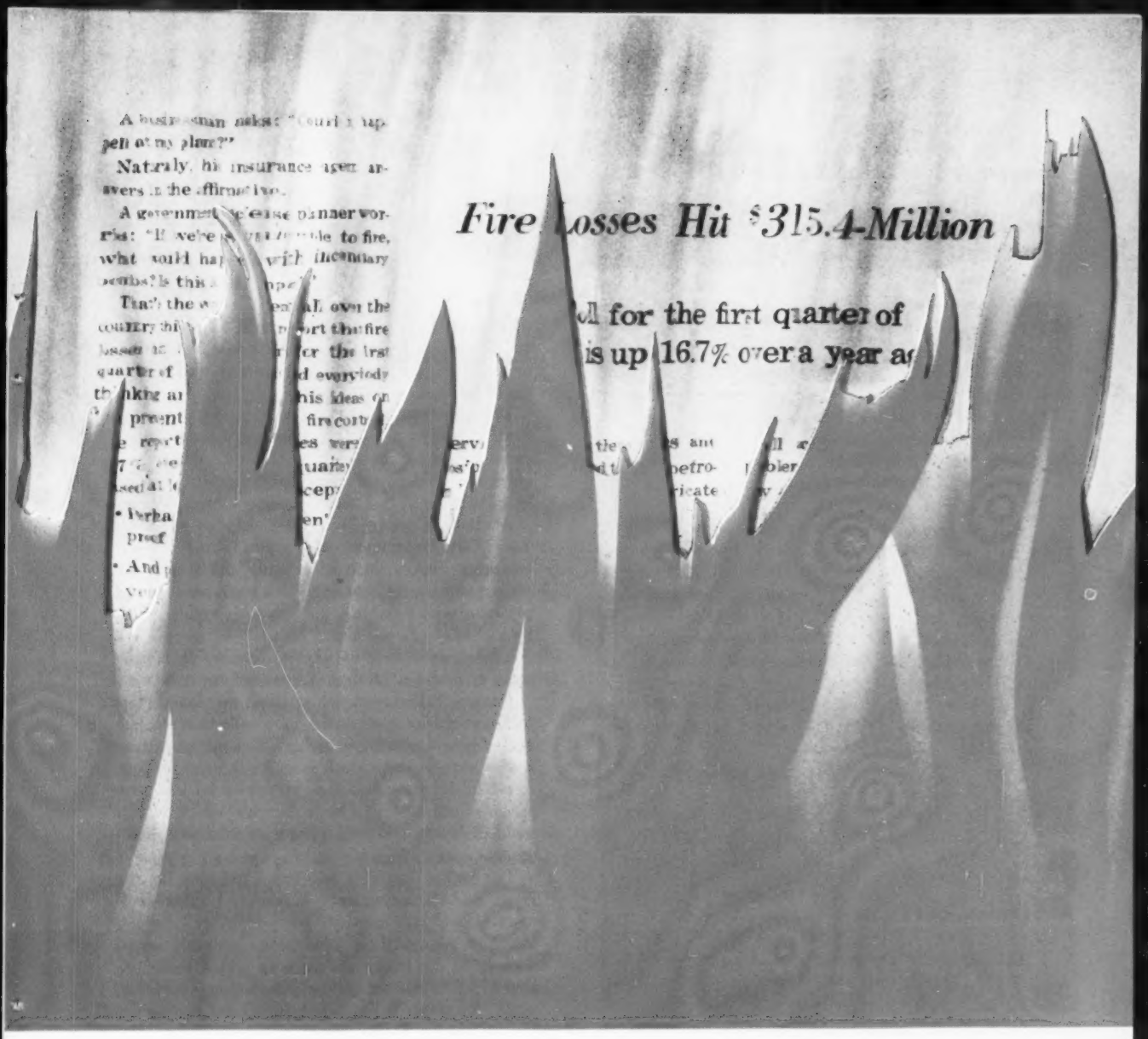
Each well is about 150 ft deep, 12 in. across and at first delivered 600 gpm. Flow from all wells has slowly dropped and one well is now good for only 200 gpm. The disposal wells are in trouble, too, and can just about absorb the reduced overall discharge. Our plant can't afford to lose much more capacity. Can we boost flow and avoid the expense of drilling new wells? I'd like to know how other Power readers would tackle this problem.—*JT*

What's best way to keep fuel lines and storage tanks sludge free?

Our plant includes three 35,000-lb-per-hr boilers and two 140,000-gal storage tanks containing No. 6 fuel oil. Suction line from each tank is 14 in. from bottom of the tank. Length of run from tank suction to fuel-oil preheater is about 100 ft.

Recently, plant operating efficiency has dropped about 9%. Can this be traced to sludge in the fuel oil? What's the best way to keep sludge out of lines and storage tanks? Are additives necessary? If so, how can we tell which type is best for our plant? What experience have Power readers had in similar situations? I'd like to have suggestions.—*LPP*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches.



Plan against it . . . not for it!

Cellulube fire-resistant hydraulic fluids and synthetic lubricants open up new areas of in-plant fire prevention

The stakes are high—personnel, equipment, production, reputation. No one has better reasons than industry has to plan against fire.

And with today's advances in chemistry, industry has never had more effective and specialized materials with which to do just that.

Cellulube fire-resistant hydraulic fluids and synthetic lubricants are good examples. In hydraulic equipment, they reduce the danger of uncontrollable fire caused by line breaks or other failures when flammable fluids are in use. In air compressors, these non-petroleum oils not only prevent excessive carbon formations—the main source of fire and violent explosion—but also meet the severest of lubrication requirements.

Minimizing the hazards of industrial operations through development of fire-resistant Cellulubes . . . making these functional fluids available in 6 controlled viscosities for broader application . . . this is another example of Celanese research and product development at work hand-in-hand with industry.

Celanese Corporation of America, Chemical Division, Dept. **597-E**, 180 Madison Avenue, New York 16.

Celanese® Cellulube®

Basic reasons . . . .

Acids
Alcohols
Aldehydes
Anhydrides
Esters
Functional Fluids
Gasoline Additives
Glycols
Ketones
Oxides
Polyols
Plasticizers
Salts
Solvents
Vinyl Monomers

Celanese CHEMICALS

. . . . . for improved products

Agricultural
Automotive
Aviation
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Electrical
Paper
Pharmaceutical
Plastics
Surface Coatings
Textiles

Your page for comment

BOB BELLAS, Assistant Editor

How's that again?

I'm a great admirer of POWER, but I can't help complaining about the information you give in "The British say it differently," March 1958, p 102.

In your entire listing of United Kingdom technical terms, only 12 are familiar to me. The rest all seem to me to need either explanation or correction of some sort.

Some terms given are very doubtful indeed. For example: "Electro-feeder" is a trade name for motor-driven feed pumps made by a Glasgow firm. "Neck gland drain," "boiler stool," "upstand" and "dipper" are new to me. And what in the world is a "valve belt"? Further, use of "maximum stress" as equivalent to "minimum tensile strength" is surely a mistake.

It seems to me that a table of equivalents such as this can only do harm. I would strongly recommend that all Americans keep to their own terms when writing to England unless they're absolutely sure about the words they use.

A C HUTCHINSON, *B.Sc., M.I. Mech. E., M.I. Mar. E.*
W H Allen Sons & Co Ltd, Bedford, England

A burning question

This article ("Designing a modern incinerator," POWER, March 1958, p 80) is a timely exposition of much useful combustion design data which are too little understood by many of those building and using large-scale incinerators. However, I feel that the author should have elaborated his consideration of dust-collection systems. For many years municipal-incinerator dust collection has been shackled by incredibly naive devotion to seemingly magical notions on so-called "settling velocity." But that isn't necessarily sufficient reason for abandoning low-loss high-temperature collection systems.

Doubtless some elaborate baffle systems have failed to appreciably improve simple settling-chamber performance. But is it sound engineering to close the chapter on baffling on the basis of a few attempts which may not have been thoroughly engineered and systematically investigated? It would be poor engineering indeed to dismiss without careful research and analysis the cleaning potential of the hot incinerator gases' pumping action when discharged into only moderately tall stacks. If waste-heat boilers can be justified for cooling the gases, fine; then low-temperature induced-draft fans and appropriate dust collectors are in order. But to set up water sprays—to waste energy from a notoriously wasteful process—without first carefully investigating ways in which some use might be made of available low-level energy wouldn't be engineering at its best.

Point is that most incinerator stacks provide a draft of one to two inches of water, most of which can be used by the collection system. Certainly a collection efficiency of more than 10 or 15% should be possible with that much pressure drop available.

At Battelle we've been working with the New York City Department of Public Works on performance improvement of existing and future municipal-incinerator dust-collection chambers. Model results are encouraging, but full-scale results won't be known for some time. Meanwhile, more work is needed on a wide variety of chamber configurations to find best designs for maximum collection.

During collector-model studies we found that baffles could increase or decrease collection efficiencies of simple settling chambers, depending on how baffles were placed. Much more work must be done to establish optimum design principles for low-pressure-loss refractory dust collectors which'll give good efficiency and retain low operation and maintenance costs.

The author has ably presented the case for the large modern incinerator. However, I think engineers should still consider the possibility of using low-draft-loss settling chambers, properly engineered, in the many instances in which these are a practical solution to the gas-cleaning problem.

RICHARD B ENGDAHL, *Division Chief*
Fuels and Air Pollution Research
Battelle Memorial Institute, Columbus, Ohio

. . . your article seems to us to expound favorably on a single-type grate and appurtenances for refuse incineration and we feel that it is somewhat partisan. Too, we seem unable to understand that the criteria put forth are especially new or modern.

S A GREELEY, *Greeley & Hansen, Engineers, Chicago, Ill.*

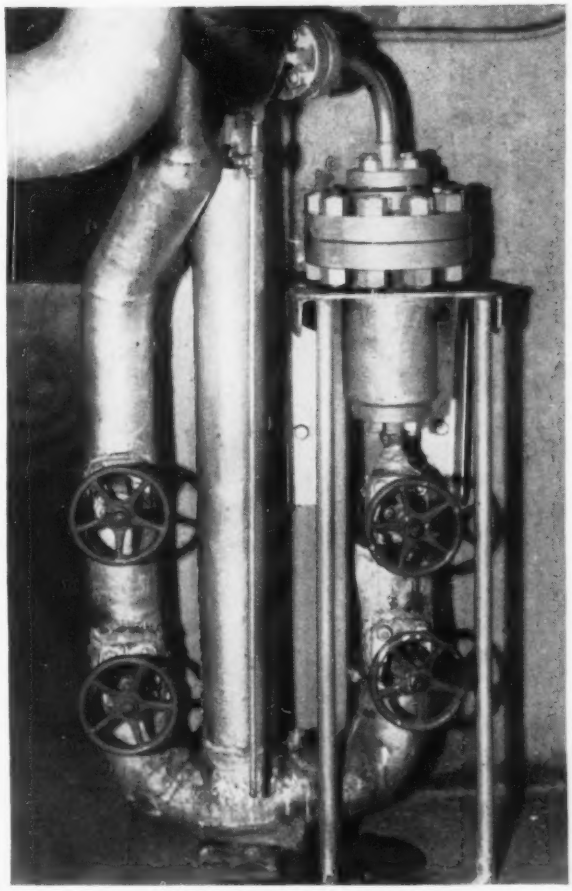
Little ones are important, too

I was pleased to see the article on economic insulation thickness (POWER, Dec 1957, p 110). Too often engineers, failing to realize cost savings involved in choice of correct insulation thickness, specify lagging sizes without thought or calculation. Figures presented in your article should awaken these people to the fact that selecting economic insulation really pays off in lower operating costs.

Example given, be- (*Continued on page* 188)

"And for extreme pressure and temperature there is a heavy duty Armstrong"

Reproduction of Armstrong Trap advertisement which appeared in power magazines in 1924.



No. 515 Armstrong flanged trap at central station—dependable protection of superheated steam lines.

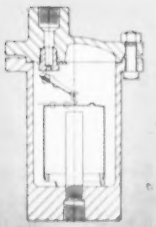
Armstrong steam traps have grown up with the increase in steam pressure that started right after World War I. Forged carbon steel bodies made their debut in 1929 with carbon moly and chrome moly steels following as pressures went up.

The traps listed below have forged carbon steel bodies and caps for service to 600 psig, 750F.; carbon moly or chrome moly to 900 psig, 900F.; chrome moly to 2500 psig and temperatures above 900. Valves and seats heat treated chrome steel or Stellite. Other working parts are 18-8 stainless except the bucket weight.

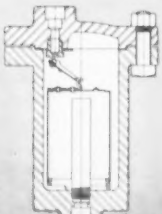
COMPLETE DATA in 44 page CATALOG J, free on request. Call your local Armstrong Factory Representative or write:

ARMSTRONG MACHINE WORKS
8125 Maple St., Three Rivers, Michigan

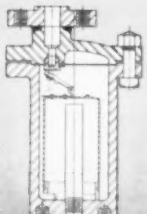
SCREWED, SOCKET WELD AND FLANGED CONNECTIONS



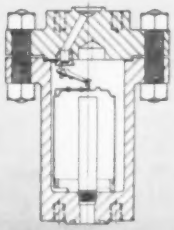
Screwed ½" to 2"—pressures to 900 lbs.



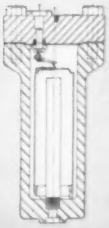
Socket weld ½" to 2" pressures to 900 lbs.



Flanged connections —½" to 2" pressures to 900 lbs.

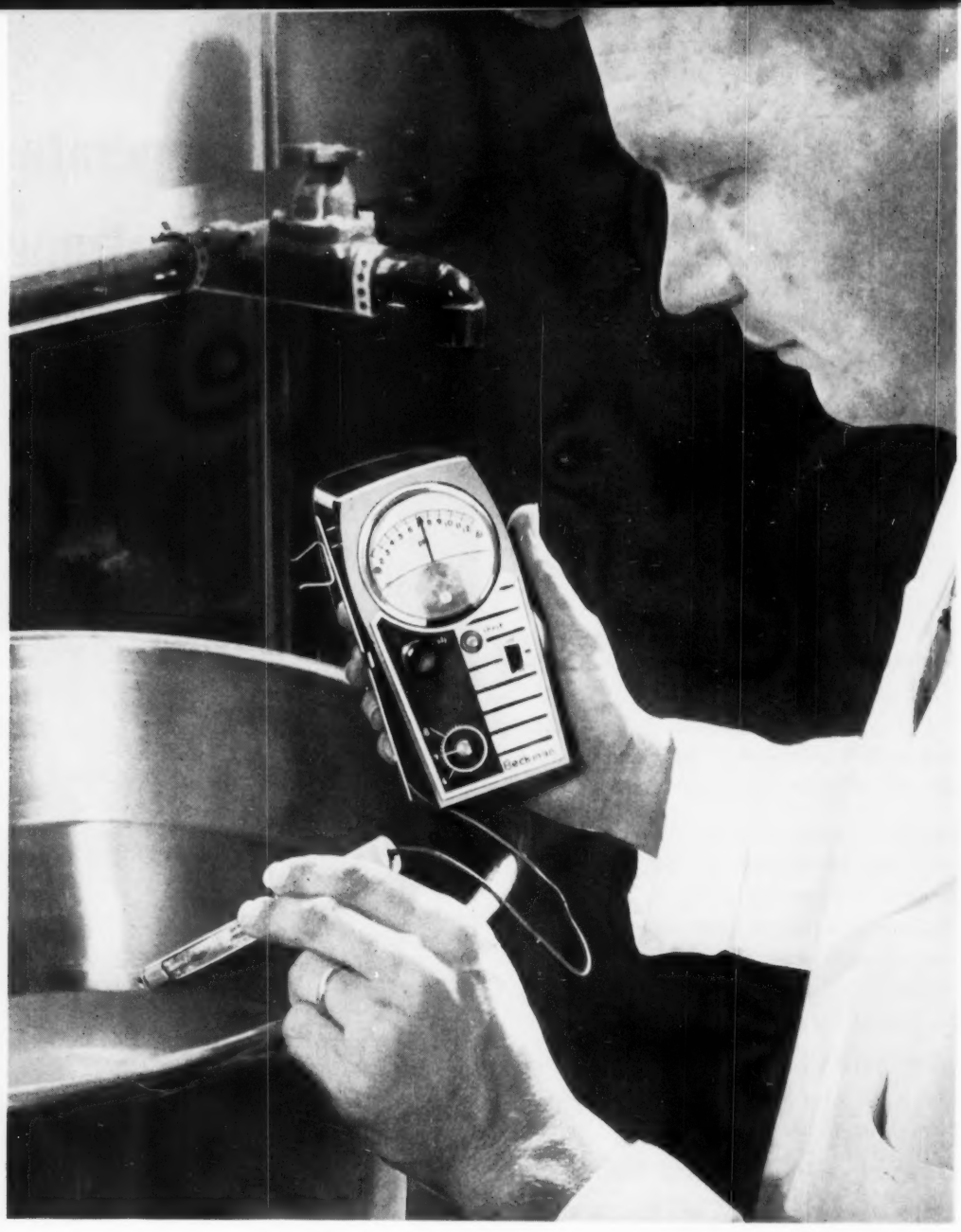


No. 515 trap—socket weld or flanged 1" or 1¼"—pressures to 1500 lbs.



No. 615 trap—socket weld or flanged 1" or 1¼"—pressures to 2500 lbs.

ARMSTRONG INVERTED BUCKET FORGED STEEL **STEAM TRAPS**



How to use a portable pH meter

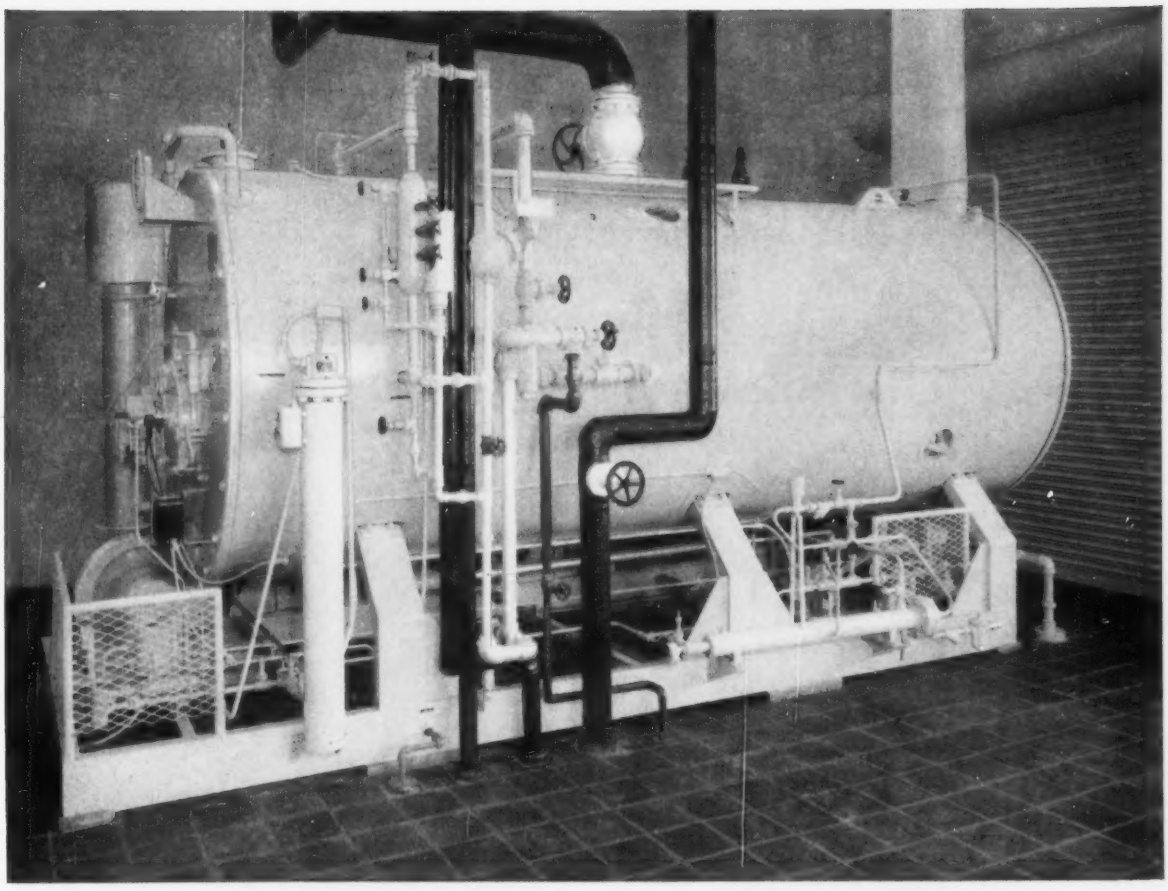
You can solve many pH control problems—acidity and alkalinity—with this portable pocket-sized instrument. Costing less than $100, you get on-the-spot pH readings in the laboratory, plant or any field installation.

Meter is valuable for a wide variety of pH jobs. For example, it's used in testing feedwaters to prevent equipment and pipeline corrosion, and in spot-checking automatic systems that control wash, waste, cooling tower, blowdown and boiler waters around your plant.

Unique feature is the combination glass and reference electrode with a convenient 36-in. lead. This sensitive electrode may also be used while clamped to the side of instrument—allowing you a free hand to make notations.

Meter is 6-in. long, 3-in. wide, 2-in. deep and weighs 2 lb. Measurements in the range of 2 to 12 pH are possible with readability adjustment.

Power is supplied by six standard batteries. The two-tone gray case, made of acid-resistant melamine plastic, has a scratch-resistant polystyrene dial face.—*Courtesy, Beckman Instruments Inc, Scientific Instruments Div.*



200 HP AMESTEAM GENERATOR Installation at U. S. Concrete Pipe Co.

LOW COST STEAM DELIVERED BY AMESTEAM GENERATORS

BRINGS REPEAT ORDERS FROM U. S. CONCRETE PIPE

Why is it that AMESTEAM GENERATOR customers are almost always *repeat* customers? The reason can be summed up in these words: "Lower Cost Steam". One of these repeat customers is U. S. Concrete Pipe Co., Relay, Md. This firm is one of the leading producers of large concrete drainage pipe and allied products.

Recently the company needed a boiler to supply steam for the structural curing of various concrete products. Successful experience with the AMESTEAM GENERATOR "Package" Boilers proved elsewhere in other plant operations led to selection of the 200 HP unit shown above. U. S. Concrete Pipe found that this AMESTEAM GENERATOR provides the most economical and efficient solution to this important steam problem.

Here is another of the hundreds of users whose complete satisfaction with AMESTEAM's low-cost, dependable performance is indicated by the repeat orders we continue to receive from them. This record for repeat orders is based on AMESTEAM GENERATOR's reputation for *Low Cost Steam*, faithfully delivered over a long period of years.

What's YOUR Steam Problem?

If you need 10 to 600 HP and want the kind of space-saving, trouble-free service enjoyed by satisfied owners of AMESTEAM GENERATORS, write today for our catalog and the name of your nearby Amesteam Dealer.

AMES IRON WORKS, INC.
Box H-58, Oswego, N. Y.

Basics . . . bringing engineering theory down to earth

NORMAN PEACH, Assistant Editor

Electricity: 21

How synchronous motors work

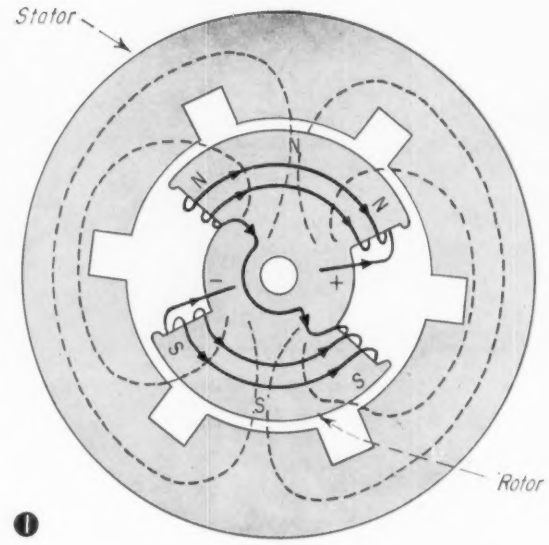
The stator of a synchronous motor resembles that of an inductor motor, as described in *Basics* No. 18, February 1958. The winding consists of coils placed in slots in the core and connected in wye or delta. The rotor, however, is wound with coils similar to the field coils of a dc motor. The rotor winding is energized by direct current fed in through two slip rings; one connected to the positive field terminal, the other to the negative. These slip rings are mounted on the shaft in the same manner as a commutator. Brushes riding on the slip rings are connected to the dc source.

Direct current in the field, or rotor, provides a steady magnetic flux. If the stator were not energized, this flux would flow in the stator and rotor cores, as shown in sketch *1*. If the stator is energized by 3-phase alternating current, a rotating magnetic flux is produced in the same way as in an induction motor. As long as the rotor remains at rest, the rotor and stator fluxes do not combine to produce torque. But if the rotor can be brought up to speed by some other means, it "locks in" with the rotating stator field. That is, the rotor and stator fluxes combine in such a manner that the rotor is dragged around by the rotating field.

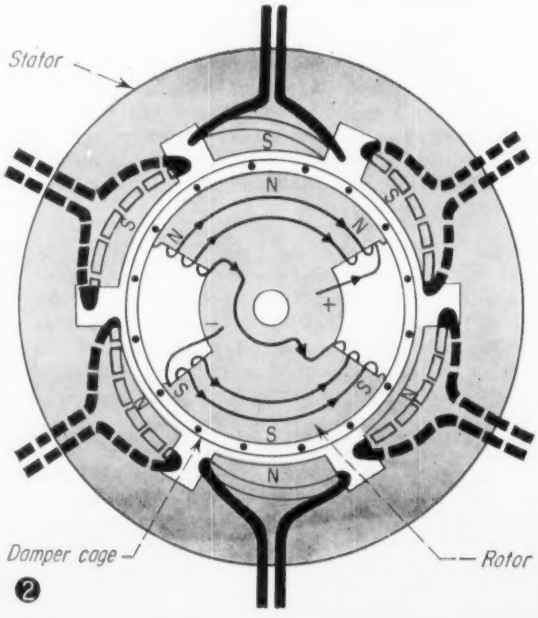
Once up to speed, the rotor follows the rotating field without slipping. Since it is supplied with external excitation, it differs from the rotor of an induction motor in that it does not need to slip in order to be energized. Hence, the motor gets its name—synchronous—because the motor's speed is in synchronism with the rotating fields, as determined by frequency of ac power supply.

As we have seen, synchronous motors are not naturally self-starting. To bring the motor up to sufficient speed for it to lock in synchronism, a cage similar to the rotor winding of a squirrel-cage motor is placed around the rotor. The bars are embedded in the pole forces. Thus, the motor starts as an induction motor, current being induced in the cage as long as there is slip. When synchronism is reached, the cage no longer cuts flux, and, therefore, produces no torque. The cage winding tends to pull the rotor back into synchronism should it try to run too fast or too slow. Therefore, it is often called a damper winding.

Small synchronous motors sometimes use permanent magnets in place of coils energized with direct current. One example is an electric clock motor. Permanent-magnet synchronous motors are made up to several horsepower.

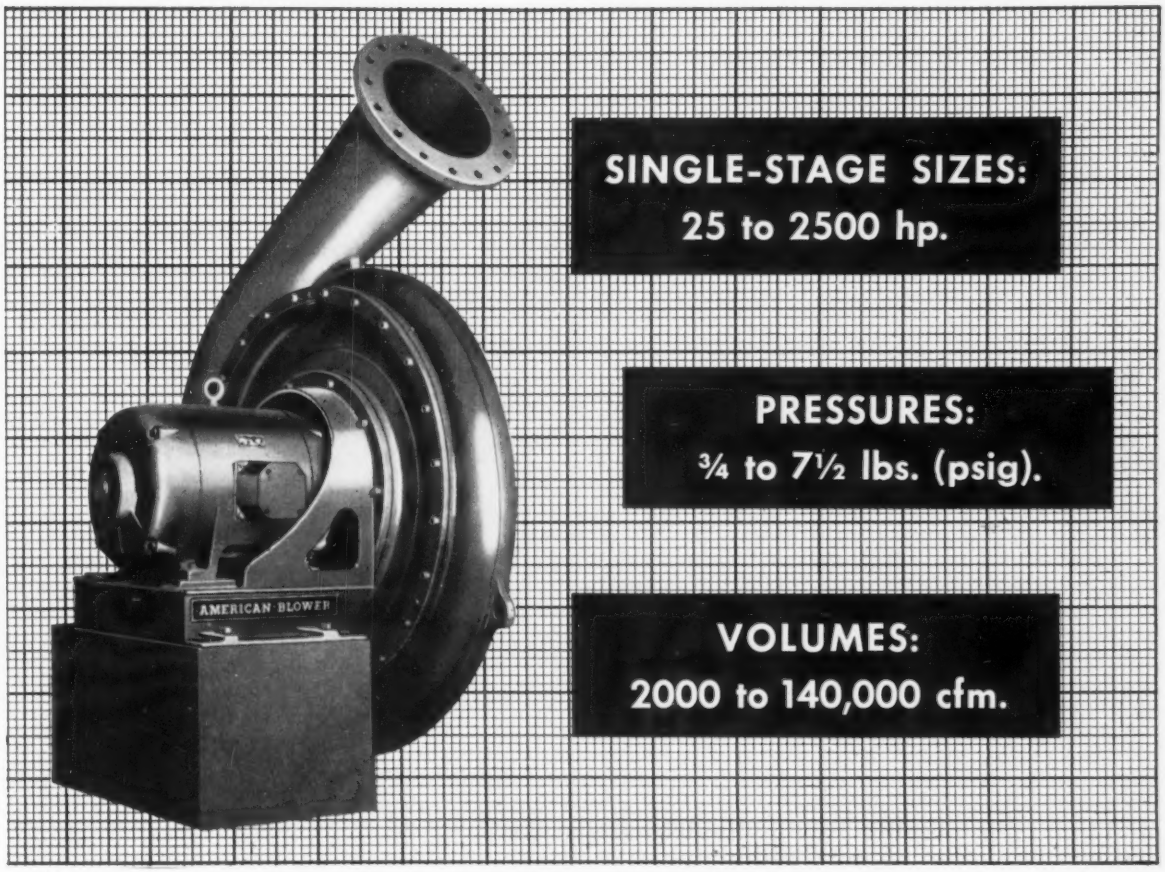


1



2

American Blower Centrifugal Compressors



Rate centrifugal compressors for dependable performance, ability to meet specific pressure-volume requirements, minimum space and maintenance requirements. You'll find that American Blower single-stage units score high on all counts.

Adaptable to all drives, American Blower Centrifugal Compressors feature volute casings for increased efficiency. Compressor discharge can be located in increments of 15° in either direction of rotation, permitting great flexibility in application.

Compactness, high-speed operation, statically and dynamically balanced rotating elements minimize foundation requirements. Aerodynamic design of impeller blades contributes to efficiency, assures longer service life.

If you have an application calling for centrifugal compressors, talk to an American Blower sales engineer about your specific requirements. And check with him about American Blower Mechanical Draft Fans, Fly Ash Precipitators, *Gyrol*® Fluid Drives for boiler-feed-pump and fan control. His practical knowledge of air-handling and power-transmission problems may prove most helpful to you.

Call your nearby American Blower branch office, today. Or write: American-Standard,* American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

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American-Standard Products

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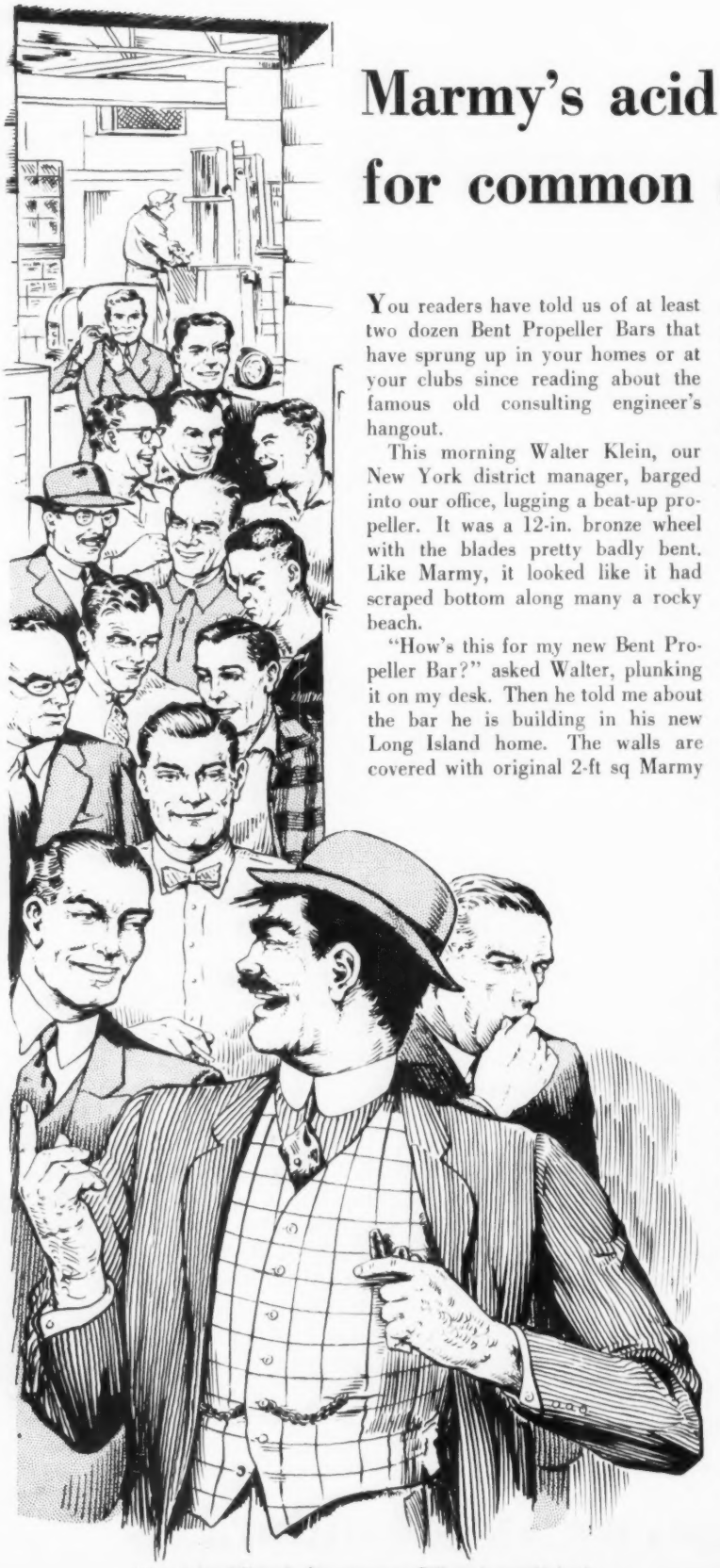
Marmy's acid test for common sense



"The boys followed the manager, Bill and myself back to the office after I scored a bull's-eye," Marmy chuckled.

You readers have told us of at least two dozen Bent Propeller Bars that have sprung up in your homes or at your clubs since reading about the famous old consulting engineer's hangout.

This morning Walter Klein, our New York district manager, barged into our office, lugging a beat-up propeller. It was a 12-in. bronze wheel with the blades pretty badly bent. Like Marmy, it looked like it had scraped bottom along many a rocky beach.

"How's this for my new Bent Propeller Bar?" asked Walter, plunking it on my desk. Then he told me about the bar he is building in his new Long Island home. The walls are covered with original 2-ft sq Marmy sketches, a blown-up autographed portrait of the foxy gent, and now this bent propeller.

Since it was almost noon, Walter and I wandered down along the waterfront to visit our hero's hangout. Stepping inside, we ran into our good friend Quaid Minich and a few other shipmates. Marmy was leaning against the bar, nursing a bottle of Sandpaper Gin. As usual, the place was packed with seafaring men and waterfront characters.

Just about the time we got settled at a table, Marmy suddenly roared, "BILGEWATER on automatic elevators, I'll tell you throttle pullers about the time I licked a low pH problem, and all I used was a little water." That did it. Almost instantly, the noisy place became quiet as all eyes focused on Marmaduke Surfaceblow. Turning to his audience, Marmy sized us up deliberately, gave his gray bowler a starboard list, then roared away in his foghorn voice.

"Back in 1938 I was chief engineer on the West Coast diesel fishing trawler *Dorothy McSquid*. After one highly successful trip during the salmon season, we tied up at a big cold-storage plant in Tacoma, Wash.

"Soon as I heard my former shipmate Bill Sorensen was the plant's chief refrigeration engineer, I headed for his office. It was coffee time and there was the usual bull session going on. After his gal brought me a cup of coffee, I put my feet up on a desk and joined in.

"Bill and his assistants were griping about a brine problem that had everyone doing some serious head scratching. After a few questions I got the whole story: The plant had two main storage rooms, 100x100x20 ft. These rooms had direct-expansion, flooded-coil brine-spray cooling units. And each unit handled 18,000 cfm of air.

"Sodium chloride brine was used. To protect the galvanizing, they added sodium dichromate. Idea was

(*Continued on page* 170)

HERE'S A
SPECIAL ADVANTAGE
OF THE
LJUNGSTROM:®

high availability

These five basic factors assure you that the Ljungstrom Air Preheater will give exceptionally long periods of uninterrupted availability:

1. **UNIFORMLY HIGHER COLD-END METAL TEMPERATURES.** This minimizes the danger of local corrosion due to cold spots.

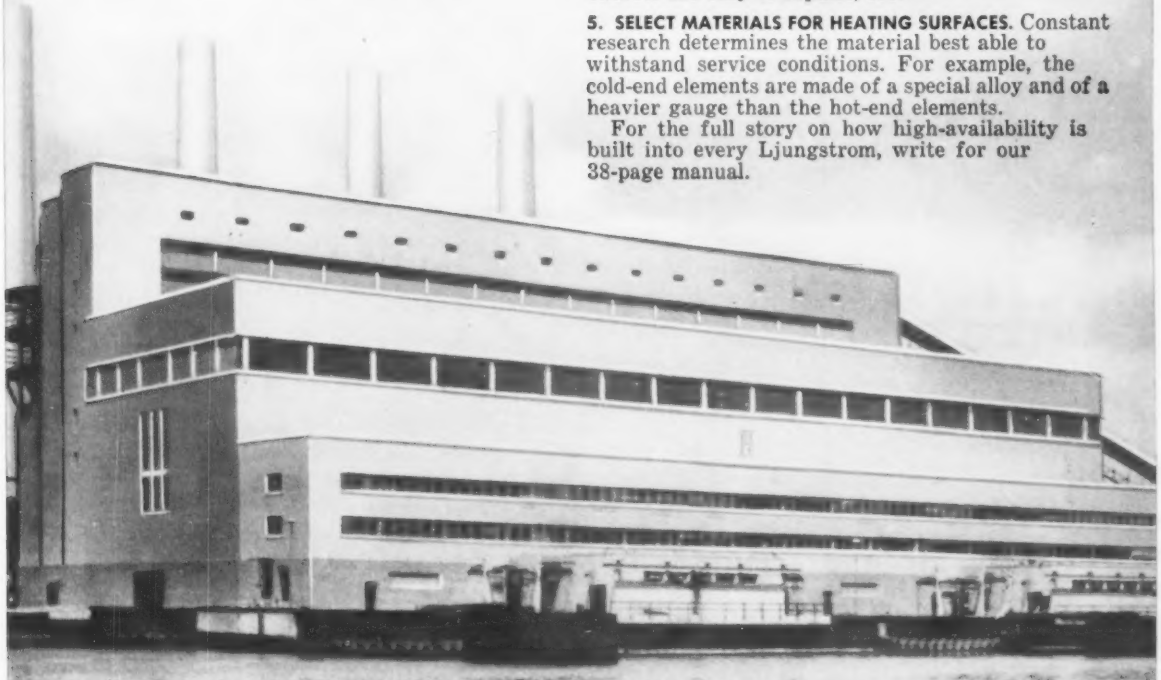
2. **POSITIVE CLEANING ACTION.** A mass-flow soot blower is normally installed at the cold end of the Ljungstrom where deposits are most apt to accumulate. Daily cleaning with superheated steam or compressed air removes any deposits.

3. **INSPECTION PORTS.** You can see for yourself, at any time, the condition of the heating surfaces.

4. **REVERSIBLE COLD-END BASKETS.** Elements in the cold end are separated into small baskets, which can be inverted when one end starts to wear thin. These baskets are easy to replace, too.

5. **SELECT MATERIALS FOR HEATING SURFACES.** Constant research determines the material best able to withstand service conditions. For example, the cold-end elements are made of a special alloy and of a heavier gauge than the hot-end elements.

For the full story on how high-availability is built into every Ljungstrom, write for our 38-page manual.



The Air Preheater Corporation 60 EAST 42nd STREET, NEW YORK 17, N. Y.

Reader service section

Start with these quick samples . . .

What's up in Brussels?

Paris built the Ferris Wheel, the Trylon and Sphere towered over New York, everyone met in St. Louis—and now Brussels is the site of the latest World's Exposition. It's a sort of industrial Olympics, with crowds of visitors watching as nations vie to put on the best display. For some of our country's prestige-winning exhibits, check . . .

Reports from the field, p 144

Problems . . .

in the bus-transfer line aren't as bad as they may seem, even with today's large-sized generating units, says a recent paper. Four GE men suggest methods of transferring auxiliaries from one source to another, and we've abstracted their report to brief you on what's new. For the latest on switchgears and other topics, see . . .

Technical briefs, p 146

Togetherness . . .

when it comes to machinery, is probably best promoted by a good coupling. We have three of these fellows listed, all no-lube jobs with a variety of other features: 3-part design for one, corrosion resistance for another, 1800 in.-lb torque capacity for the third. An inner-cooled transformer is another item of interest in . . .

Plant equipment news, p 150

Need any help?

With school almost out, the constant flux begins again. Seems as if half the world is looking for a job; the other half trying to fill a job. There may be no foolproof rule for getting the right man to work for you, but if you want to scare your man away, there are some surefire things you can do. For a checklist of "don'ts," read . . .

George Edwards, p 156

Do call on us . . .

for your spring reading matter. Our listing of manufacturers' literature will give you tips on what to read about, to check, and to order for your plant. This month we have pamphlets on air conditioning, boiler auxiliaries, electrical equipment, safety equipment, maintenance materials and a whole lot of other subjects, in . . .

Free literature, p 157

For other timely ideas, see following service pages▶

When you need

a tough fan for a tough job...

INDUSTRIAL PROCESSES

BOILER GAS RECIRCULATION

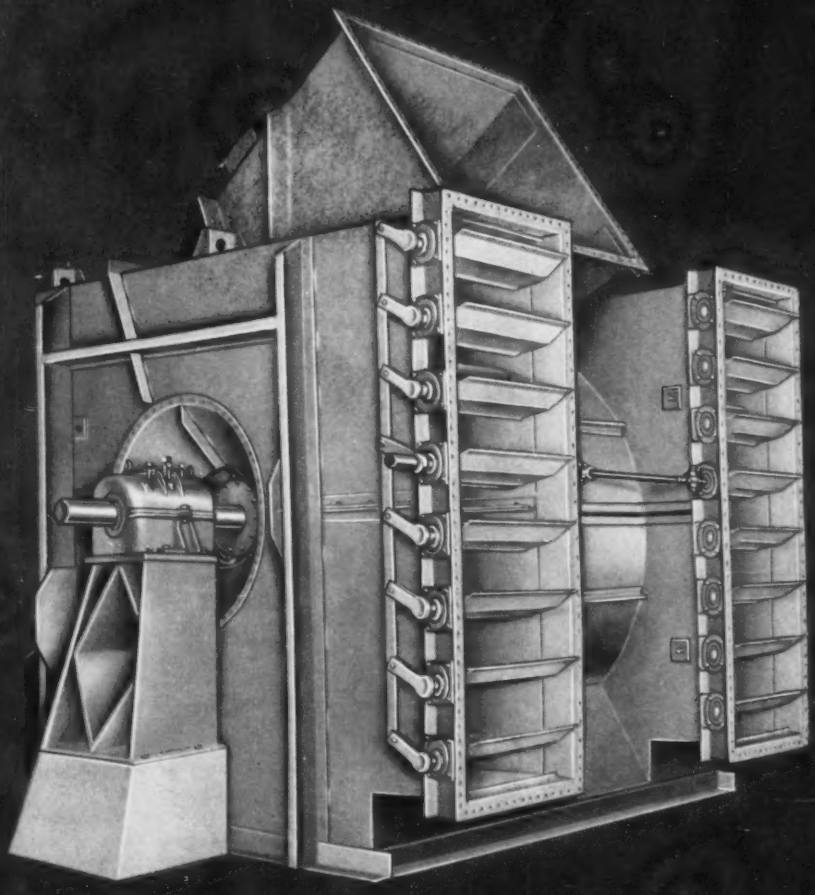
ORE SINTERING EXHAUST

ROTARY KILN EXHAUST

BLACK LIQUOR INDUCED DRAFT

WASTE HEAT INDUCED DRAFT

STEEL MILL FURNACE CIRCULATION



Westinghouse offers you a Heavy-Duty Fan... the right type...the right size...the right blading

Remember this: American Industry invests more in Westinghouse Heavy-Duty Fans than in any other.

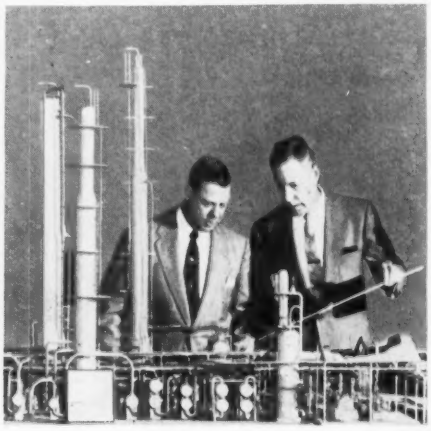
Call your nearest Sturtevant Division Sales Engineer, or write Westinghouse Electric Corporation, Dept. E-15, Hyde Park, Boston 36, Massachusetts.

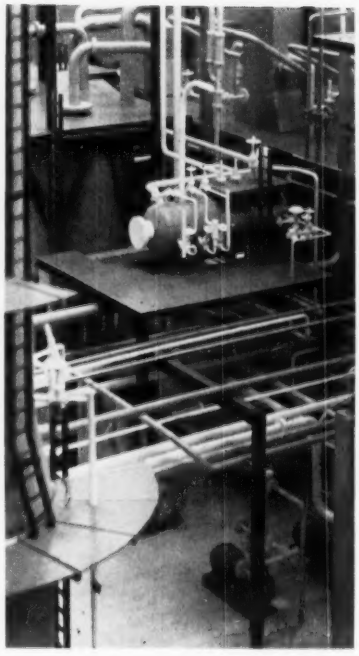
J-80662

YOU CAN BE SURE...IF IT'S Westinghouse

Reports from the field

What's happening in power and what it means to you





FUEL CELL, *above,* prefabricated models, *right,* are part of the U.S. bid for top industrial-progress honors at Brussels. There are 44 in this industrial Olympics

Stakes are high at Brussels World's Fair

"Let's show the world our story of achievement" is the battlecry, as industries of 30 nations vie to make the best impression on the hordes of sightseers. At the Brussels World's Fair, world's largest and most glamorous showcase, each country has its best opportunity in years to demonstrate what it's done—and each has the chilling realization that failure to shine can have some far-reaching reverberations, prestige-wise.

One of the U.S. exhibits will be National Carbon Co's fuel cell, a unit which pro- (*Continued on page* 206)

Power lines

New headquarters of the American Society for Metals will be dominated by an all-metal geodesic dome. Dome will contain 5¼ miles of aluminum tubing, 7¾ miles of tension rods. Headquarters building is underneath.

Mechanical-drive turbine units have finally left the shadow of their big brothers and moved into a limelight of their own, says the General Electric Co. Small Turbine Dept has packaged a sales and education program to carry the story to 29 cities in the U.S. and Canada.

ASME has come out with the latest batch of test codes; three covering fuels for diesel engines and heat generation, deaerators, and water-cooling equipment.

Floating tubular plastic bags, filled with fuel oil or chemicals and towed by tug boats, may reduce shipping costs 60 to 80%. Giant 20,000-gal bags are 100-ft long, can be towed like barges to form sea-going pipeline.

Solar-heated house, the first one in America to get *all* heat from the sun, is now nearing completion.

Price of demolition is high. Union Electric Co recently tore down a 225-ft stack, spending $13,470 in the process. When the stack was built in 1921, it cost $8740.

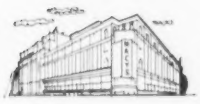
Electrorefining of nickel by direct electrolysis of nickel matte eliminates high-temperature oxidation and reduction operations, says International Nickel Co. Lukens Steel Co rolls four corrosion-resistant alloys in clad-plate form: Hastelloy B, F, C, and titanium. Hard-N-Tuff Corp has developed a non-chip case-hardening process.

Power to Grow idea has spread to private housing, with design of two homes to grow with the family. When you buy a house, you get sets of plans for future expansion.

For Calendar of Events, turn to page 208

It's CHASE® Bus Conductor in the world's largest department store

Chase Bus Conductor installation at R. H. Macy handles 20-25,000 Amp. Power



Back in '48, New York's famed R. H. Macy store re-vamped its power supply system—replaced its generators with rectifiers to supply DC for elevators, air conditioners, fans, pumps and other equipment. The system handles 20-25,000 amperes of DC at 120-240 volts. 5" ventilated square copper tube bus conductors by Chase® carry AC from Utility Company services to service switches and rectifiers. Large quantities of flat rectangular bus bar by Chase carry DC in the rest of the run. Total quantity Chase® Bus Conductors of all types is over 30,000 lbs.

To date, there has been no trouble with this installation in spite of heavy current demands found in the world's largest department store.

Your nearest Chase Representative can give you full information about Chase® Bus Conductor in a wide range of sizes and shapes. Or get in touch with Chase at Waterbury 20, Connecticut.

Building: **R. H. Macy Store,** New York
Architect: **R. G. Belcher**
Engineers: **Kaiser, Muller & Davies,** New York
Contractor: **Cole Division of Federal Pacific Electric Company,** Long Island City

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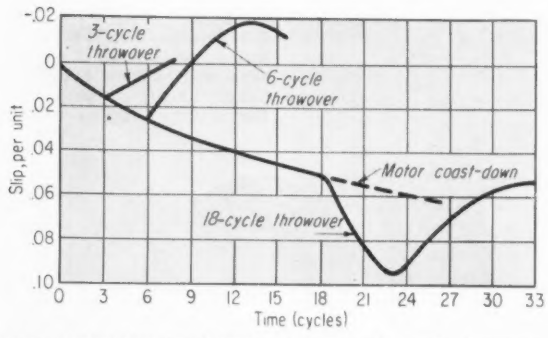
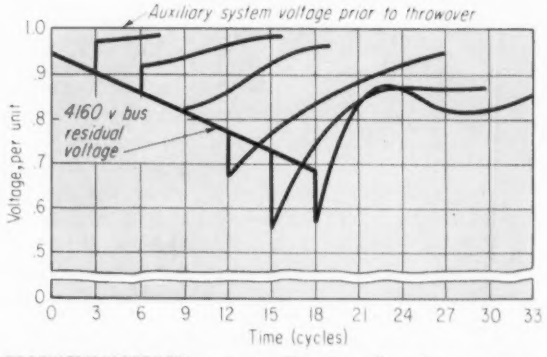
Technical briefs

Latest engineering developments for busy power men

10 papers for you on:
SWITCHGEAR
COMPUTERS
INSTRUMENTS



FAST AUXILIARY TRANSFER, using 3- and 6-cycle throwover, permits quick motor-speed recovery, cuts bus-transfer problems



RECOVERY VOLTAGE on the auxiliary bus. Note the severe transient dips in bus voltage at throwover times of about 15 cycles

Fast-closing breaker improves bus transfer

Switchgear with stored energy mechanism applied to steam station auxiliary transfer arrangements. *By P G Brown, D G Lewis, J J Heagerty and E M Smith, General Electric Co.*

The problem of transferring auxiliaries from one source to another has become more difficult as the size of generating units has increased. This paper suggests methods of transfer, using a metalclad breaker with a 5-cycle closing time which practically eliminates bus-transfer problems.

Where units are installed on a unit system, the reserve source is usually taken off the high-voltage system, the normal source is taken off the generator terminals, and the voltage sources to the auxiliary bus are essentially in phase. The authors assume that the normal and emergency sources of power to the auxiliary system are essentially in phase.

To emphasize what is to be gained by using the breaker with five-cycle closing time, the authors review the usual methods of transferring auxiliaries during routine and emergency transfer. They then go on to explain transfer using the breaker with 5-cycle closing time.

Transfer times of three and six cycles are possible. In 3-cycle transfer, the signal for tripping one source breaker and closing the second source breaker are given at the same time. Thus external voltage is removed from the bus for a maximum of three cycles. This method of transfer can be used for both routine and emergency transfers. It eliminates problems of voltage dip, recovery time of motors, excessive shock to the motors, and boiler instability due to motors slowing down. It does so with a minimum of relaying and with no paralleling of sources.

A 6-cycle transfer does not permit the incoming source breaker to close until contact on the tripping breaker indicates it has tripped. The authors conservatively list this method of transfer for emergency use only.

Sketches above show the faster recovery of normal operating speeds and normal voltage when the faster throw-overs are used, as opposed to 18-cycle transfer. *AIEE paper, No. 58-93.*

High capacity current limiting fuses today. *By E M Fitzgerald and V N Stewart, General Electric Co.*

The emphasis in the development of low-voltage high-capacity fuses today is to meet the challenge of coordinated protective applications through a real current-limiting ability. This is a need that has grown in importance as has high interrupting capacity with the total electrical power generation and the increasing load concentrations in low-voltage utilization.

The authors define current-limiting fuses and describe a new one that has been developed with an interrupting rating of 200,000 rms symmetrical amp at rated voltage and frequency. Among other things, they discuss current-limiting ability of the new line of fuses and use of the time-melting current characteristic curve. *AIEE paper, No. CP-58-131*

An experience with breaker restriking and arrester destruction on the Pennsylvania Power & Light Co 220-kv system. *By M C Galiyano, C A MacArthur and W F Mackenzie, Pennsylvania Power & Light Co.*

This paper presents an experience of the Pennsylvania Power & Light Co which involved damage to an oil circuit breaker and lightning arresters

(*Continued on page* 148)

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JOHNS-MANVILLE

More **technical briefs**

Begins on page 146

during switching on a 220-kv system. The investigation of these damages was conducted on the actual system and a transient network analyzer.

The authors conclude that (1) The breaker at Bushkill would not drop the 220-kv line alone without multiple restriking. During each of the seven line-dropping operations on December 2, 1956, there were three or four restrikes in each phase. These restrikes caused permanent damage to the breaker interrupters. (2) Analyzer tests indicate that resisters can effectively control restrike voltage magnitudes and thus prevent overvoltage damage to other electrical apparatus. (3) The lightning arresters at Peckville were destroyed by cumulative heating resulting from repetitive discharges of switching surge and power-follow currents. *AIEE paper, No. 58-94*

Computers

Digital computer aids economic-probabilistic study of generation systems; Part 1. *By M K Brennan, C D Galloway and L K Kirchmayer, General Electric Co.*

This paper describes how a medium-sized digital computer, *IBM 650*, may be used to calculate the probabilities of capacity outage and loss of load for a noninterconnected system.

In the past, the time required for manual calculation of these functions, even for a system of moderate size, has restricted widespread use of probability methods. The procedures outlined in this paper give a rapid and economic way to obtain the probability of capacity outage and the probability of loss of load. *AIEE paper, No. 58-142*

Digital computer aids economic-probabilistic study of generation systems; Part 2. *By C D Galloway and L K Kirchmayer, General Electric Co.*

Paper describes how an internally programmed digital computer can be used to evaluate the cost of expanding a power system according to a chosen pattern. With the maximum-allowable loss-of-load probability specified and the probabilistic model of the generation system obtained from Part 1, the computer may be programmed to add units automatically whenever the loss-of-load probability increases above a prescribed amount. In this manner the computer proceeds to add units and calculate present worth of all costs over the desired period.

The evaluation considers that in any year, cost of expansion for that year consists of (1) investment for generation (2) investment for interconnection capacity (3) investment for intraconnection capacity (4) cost of operation and maintenance (5) cost of fuel. For each year of the expansion, each of the five component costs is evaluated. The sum of these components represents money spent to carry out the expansion in that year. Present worth of the cost of expansion for that year is determined, as well as present worth for the entire expansion up to and including the year in question. *AIEE paper, No. 58-143*

Computer analysis of transmission system capability during generator outages. *By H B Seeley, R E Briesemeister and J T Garbarini, Consolidated Edison Co of N. Y., Inc.*

In making preliminary studies of future system plans, power-flow conditions are determined for many possible generator-outage combinations. Because of the special design features of the Consolidated Edison transmission system, these power-flow calculations need not be based on a conventional ac network solution. Rather, they consist in determining real power transfer over all available paths without exceeding circuit ratings.

A comprehensive program was developed for the *IBM 705* computer. This permits rapid, thorough analysis of system power-transfer capability, with a small amount of manual effort in preparing the input data and evaluating results. Many possible generator-outage combinations are selected by the computer, the outage units removed from the system, and the optimum power-transfer conditions determined in each case.

The computer analyzes the results and prints a summary tabulation. In addition, it selects limiting cases and presents detailed information in the form of power-flow diagrams. *AIEE paper, No. 58-133*

The use of a digital computer in a generator reserve requirement study. *By H E Brown, Commonwealth Edison Co.*

If the theory of probability is accepted for determining the amount of generator reserve requirement, the program described in this paper can obtain results quickly with a great economy of engineering time. In an extensive study, 100 man-weeks of hand calculation were produced in eight hours on the *IBM 650*. The program has been used several times with excellent results. *AIEE paper, No. 58-134*

Preliminary report on survey of electric utility applications of digital computers. *By AIEE Computer Application Subcommittee of the AIEE System Engineering Committee and AIEE Applications Subcommittee of the AIEE Computing Devices Committee.*

This preliminary report tabulates the results of a questionnaire on digital-computer programs for the solution of electric-utility engineering problems. The report is divided into two parts: (1) Electric Utility Engineering Digital Computer Programs, listing category, title, and type of computer and (2) Description of Programs, giving data on availability, problem size, input requirements, running time, calculation performed and company contact.

Programs are separated into these categories: networks, radial feeders, transmission lines; economics; mechanical; mathematics; transient

(*Continued on page* 200)

Directions for ordering papers on page 204

NO PIPE DREAM HERE

It's a power engineer's nightmare instead. Each of the pipe specimens shown here had to be replaced. The cost of the particular nipple or elbow was minor. However, the cost of down time and replacement was expensive, indeed. And the cause in every case was either inadequate or incorrect water treatment.

A Consulting Service for You. Whatever your water problems...analysis, testing or treatment procedures for boiler water, condensate, cooling towers, process waters...Dearborn has the engineers, the experience and the laboratory facilities to assist you in developing the program exactly suited to your needs. Your Dearborn Engineer will outline the many advantages a Dearborn Consulting Service Program will give you.

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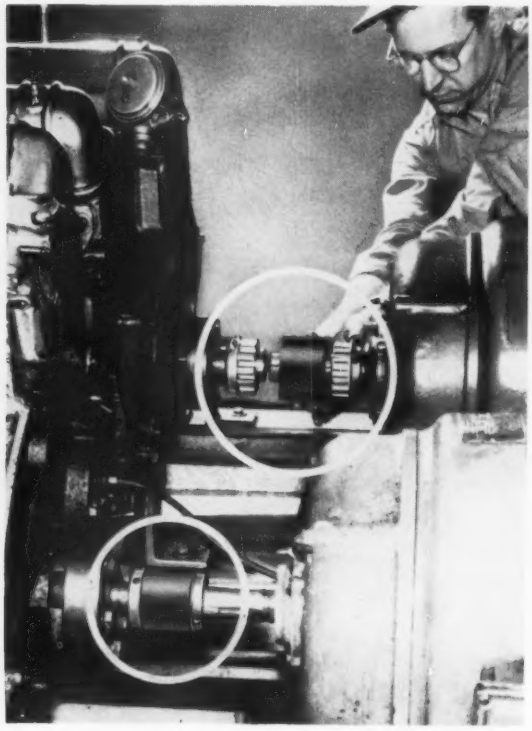


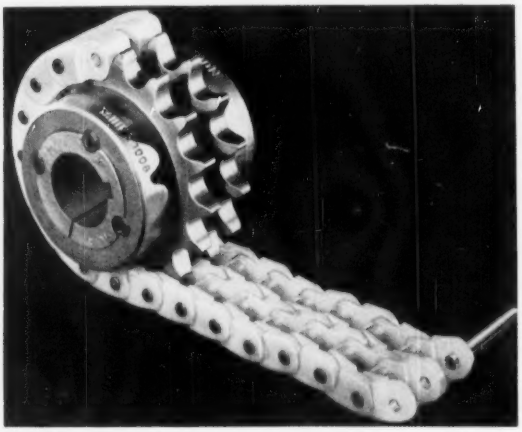
This flexible coupling has only three parts

501 • Positive dry coupling is built to cope with troublesome power-transmission conditions. It is made of a heat- and oil-resistant neoprene sleeve with axially molded internal teeth, and two metal end-fittings with grooves to match the sleeve's teeth.

Simple design is said to keep initial and maintenance costs low. The overall length of the unit can be varied by increasing length of sleeve section. The neoprene teeth move easily and positively in the grooves of the end-fittings, eliminating metal-to-metal contact and requiring no lubrication.

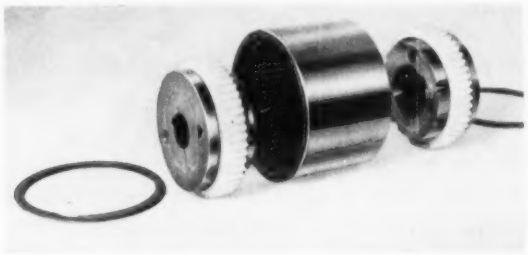
Coupling is designed for safety, according to the manufacturer. In case of severe overloads, the rubber sleeve expands and end-fittings revolve. A 30-deg twist angle allows the unit to absorb load pulsations, shocks and torsional displacements.

Couplings come in two basic hub sizes, with 2-, 4- and 6-ply rubber variations to change torque capacity. They meet requirements for loads up to 40 hp at 175 rpm; torque loads up to 1440 in-lb.—*United States Rubber Co, 1230 Avenue of the Americas, New York, N. Y.*



Nylon coupling resists corrosion

502 • Chain element of this lube-free flexible coupling is made of nylon segments and stainless-steel pins. It can be disassembled or connected at any link without special tools, maker claims, and fits standard stock-steel sprockets. The unit needs no protective cover. It handles loads from fractional to 40 hp, speeds from 500 to 5000 rpm.—*Morse Chain Co, Ithaca, N. Y.*



Coupling takes 1800 in.-lb torque

503 • Interchangeable bushings, lube-free operation are features of this unit. Stress-relieved injection-molded nylon gears, held in place on the steel hubs by spring rings, makes a smooth, resilient contact with the steel sleeve. Coupling weighs 6½ lb, is said to be compact enough to fit on short shaft extensions.

The interchangeable bushings are available for shaft sizes from ½ to 1⅝ in. They are said to save time and lower inventory costs, because only the bushings need to be stocked for different shaft sizes.—*John Waldron Corp, New Brunswick, N. J.*

For more data, use post cards, page 157. Identify request with item number.

Cities Service shows how to cut valve costs

Crane globe valve in 14th year on steam turbine line

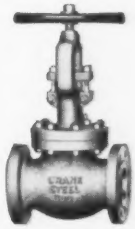
Cities Service Refining Corp. uses hundreds of valves at its Lake Charles, La., plant. Maintenance and replacement costs could be staggering, but for careful control of valve selection.

For example, the Crane 6-inch, 300-pound steel globe valve shown above was installed at the Lake Charles plant 14 years ago. Working at 250 psi., 600 deg. F., the valve is used in the steam line to a turbine-driven feed-water pump.

In spite of its operation 3 or 4 times a week, this sturdy Crane valve has continued tight in service and has required no repairs in 14 years!

Thrifty buyers want no better reward than the kind of cost-cutting, dependable service they get when Crane valves are installed.

That's why in the petroleum industry, as in all industries, you'll find more Crane valves used than any other make.



This is the valve used on installation above. CRANE 151XR, 300-pound cast steel globe valve for 850° F. maximum temp. Sizes: 2 in. to 8 in. For full details, see your Crane Representative, or write to address below.

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PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

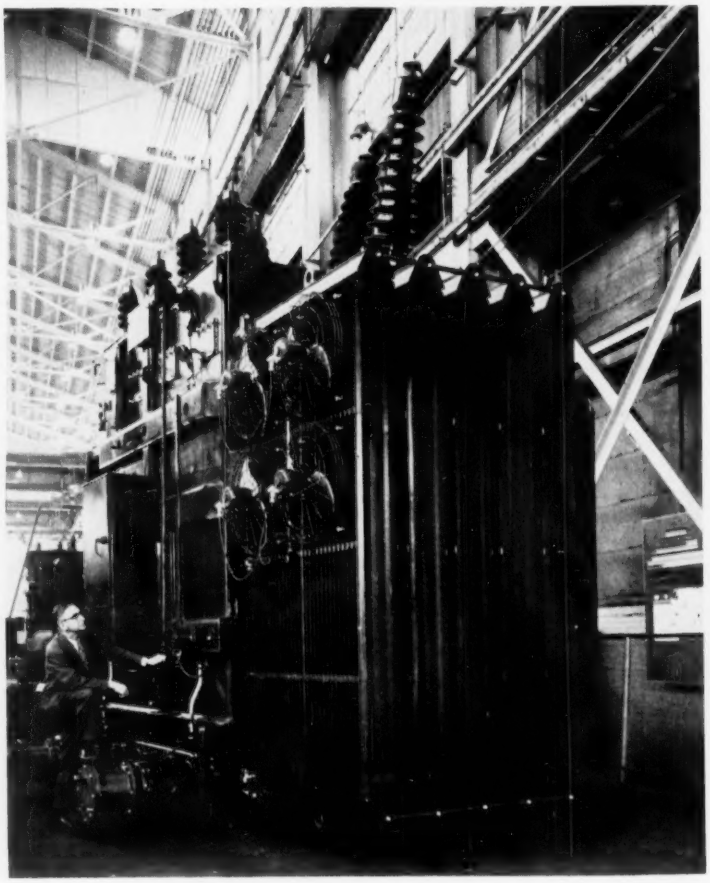
Transformer unit boasts inner cooling

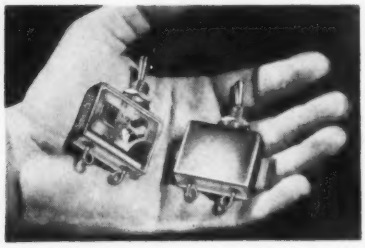
504 • Development of the "inner-cooling" principle in power-transformer design will make it possible to build units smaller, lighter and in significantly higher ratings, according to the manufacturer.

Conventional units rated up to 330 mva have already been built. The new design may up ratings to as high as 600 mva.

In "inner-cooled" transformers, oil is circulated between the strands of parallel conductors at the same potential, eliminating oil ducts between coils and windings. This allows the use of materials with higher insulation strength than oil where voltage stresses occur, so higher-capacity transformers having the same design margins as conventional ones can be built.

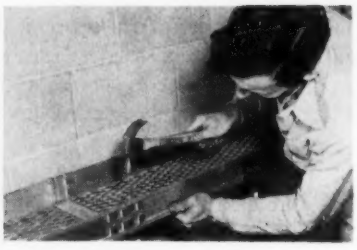
First commercial unit of the new design, right, is now being constructed. This 3-phase substation unit is rated 30/40/50 mva, 115 kv. Low voltage will be 34.5 kv. The transformer is in the 550-kv bil insulation class.—*Westinghouse Electric Corp, Box 2278, Pittsburgh, Pa.*





Subminiature circuit breaker

505 • Smaller than a matchbox, hermetically sealed series-overload breaker is designed to give stable performance under varying conditions of shock, vibration and ambient temperature, maker claims. It operates at 110 v at 60 or 400 cycles, or 50 v dc; comes in ratings from 50 ma to 10 amp.—*Heinemann Electric Co, 710 Plum St, Trenton 2, N. J.*



Aluminum cable trough

506 • Expanded-aluminum cable-supporting system includes a wide range of standard fittings to provide flexibility and low installation cost, as well as resistance to corrosion. Trough is made with solid sides for strength, maker states. Sections are secured by flat pins driven between interlocking barrels.—*T J Cope Div, Rome Cable Corp, Collegeville, Pa.*

Energizer packs power in flashlight-battery size

507 • Portable power source is said to pack the energy and high current-drain characteristics of an alkaline cell into a compact space.

The unit is designed to give high-drain continuous service in powering electronic equipment. It makes possible portable devices using transistors and vacuum tubes, and more efficient operation for portable equipment now in existence, according to the manufacturer.

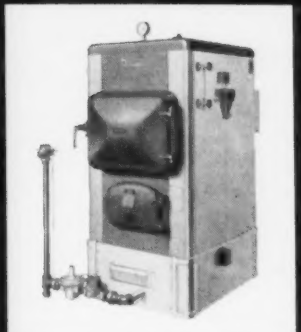
Rated at 1.5 v, unit comes in 3.8-oz and 1.6-oz sizes, with sc amperages of 20 and 8.—*National Carbon Co, 30 E 42nd St, New York 17, N. Y.*

For more details on these items, use post cards p 157. Identify your request with item number.

Oil-fired units are equipped with a Kewanee pressure atomizing burner for No. 1 or No. 2 oil. Firing rate is matched to boiler capacity. Burner and controls are shipped in separate, protective cartons, ready for wiring. Insulated metal jacket shown is optional.

new packages!

15 lb steam or 30 lb water
216,000 to 1,800,000 Btuh



Gas-fired units feature Kewanee's atmospheric type drilled port gas burner for natural, mixed, manufactured or L.P. gases. Firing is automatic . . . matched to boiler capacity. Burner and controls are shipped in separate, protective cartons . . . installation is easy.

KEWANEE® SQUARE-HEAT TYPE "R" BOILER-BURNER UNITS

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Even the largest sizes take little floor space and fit easily under an 8-foot or even a 7-foot ceiling. All the famous Kewanee features are there: 3" fire tubes expanded into tube sheet holes with ends beaded . . . large firebox for complete combustion . . . cast iron flue door, machine ground and refractory insulated . . . widely spaced tubes, large disengaging area and ample steam space.

See your Kewanee Man for further facts . . . or send coupon at right to: AMERICAN-STANDARD, KEWANEE BOILER DIVISION, 111 Franklin Street, Kewanee, Illinois.

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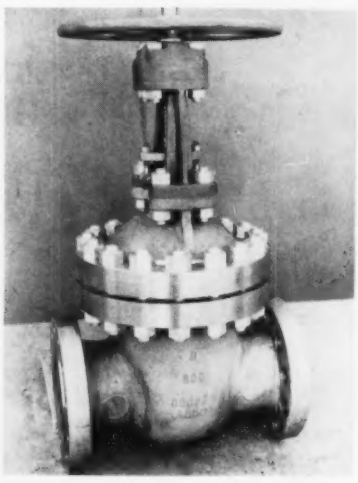
More **equipment news**

Begins on page 150

Air drive speeds valve closing

508 • A 10-in. 2500-lb valve under pressure can be closed down by one man using this assembly in 2½ minutes from full open to seat contact, maker states. Final tight shutoff is then achieved by hammer-blow action of the handwheel.

The unit's portable air motor operates from plant's 90-psi compressed-air supply.—*Edward Valves, Inc, 1234 W 145th St, E Chicago, Ind.*



Gate valve takes 1125 F

509 • Line of 600-lb series stainless-steel gate valves is designed to meet API 660 and ASA B16.5 specs.

Units come in ½- to 2-in. sizes screwed and socket weld, ½- to 8-in. sizes flanged and butt weld. They are said to have a range of vacuum to 1440 psi, –425 to +1500 F with proper packing. They operate at rated pressures at temperatures to 1125 F.—*Cooper Alloy Corp, Hillside, N. J.*

Super-alloy tubing has high-temperature strength

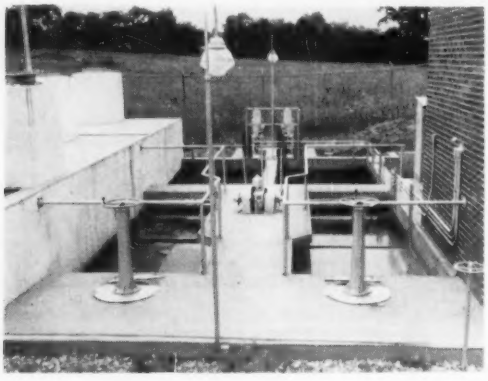
510 • Comprising 16 different analyses, tubing line is limited to heat-resistant alloys which will not rupture under a stress load of 25,000 psi at 1200 F during a 1000-hr test period. The alloys are also said to resist oxidation as well as other types of corrosion.

Special-analysis alloys used include A-286, 19-9-DL, 16-25-6, Croloy 15-15N, Inconel 702, Nimonic 75, Nimonic 80A, Hastelloy X, Hastelloy F, Waspalloy and N-155. Standard alloys available include AISI type 316, Inconel X, Nichrome V, Hastelloy C, and Haynes 25.

Other features of super alloys are retention of base hardness, absence of excessive grain growth at operating temperatures, and the ability to elongate before fracturing when overloaded. Some can be precipitation hardened for exceptional strength, according to the manufacturer.

Both seamless and welded-and-drawn tubing comes in .012 to 1.125 in. OD.—*Superior Tube Co, 1778 Germantown Ave, Norristown, Pa.*

For more data on these items, use the post cards on page 157. Identify your request with item number

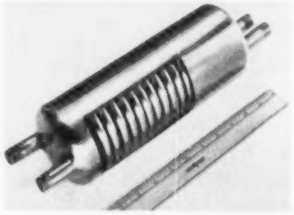


Settling tank removes solids uniformly

511 • New settling-tank design gives uniform influent distribution across the tank, uniform flow throughout entire tank length, and uniform effluent discharge from the surface of the tank, according to the manufacturer.

Unit combines a rapidly sloping bottom with multiple effluent weirs for efficient solids removal and lowered construction costs. Sludge collectors provide positive removal of scum from the surface of the liquid, sludge from tank bottom.—*Link Belt Co, Prudential Plaza, Chicago 1, Ill.*

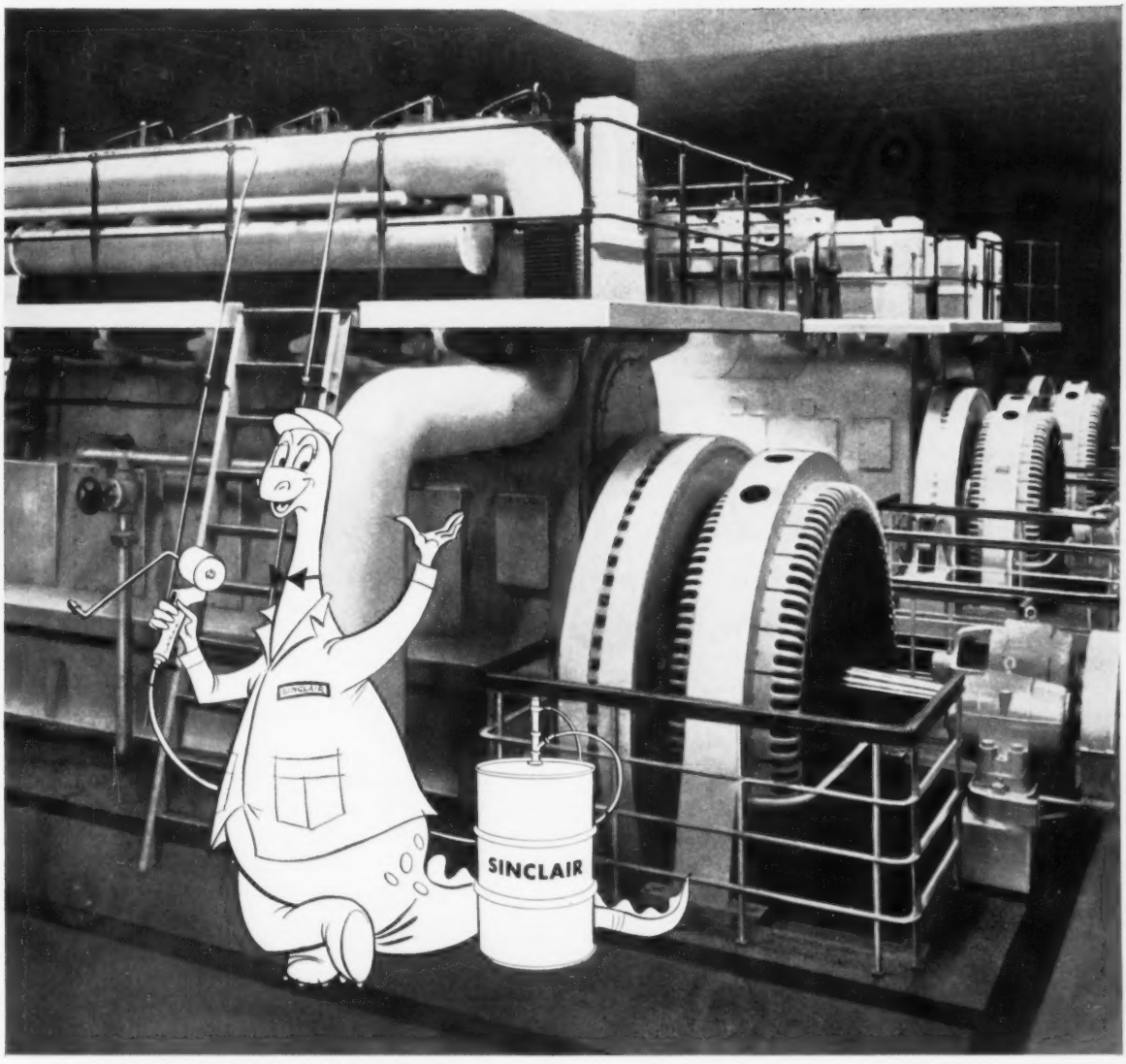
Don't miss this item . . .



Sampling container . . . . . p 164

. . . or other product news appearing on following pages

Shaft-mounted gear reducer . p 160
Indicating transmitter . . . . . p 162
Heavy-duty selector switch . . p 164
Aluminum grating . . . . . p 166
Wind-driven power plant . . . p 168
Extended-shaft fan . . . . . p 168
Ultrasonic decontaminator . . . p 169
Larger dust collector . . . . . p 169



Maintenance tips from Dino, the Sinclair Dinosaur

NOW- less oil consumption

Sinclair RUBILENE® Oil has a great reputation in industrial Diesel applications – and for several good reasons. Engineers have found that Sinclair RUBILENE can cut oil consumption, reduce service time to a minimum. It prevents the formation of harmful carbon, sludge and varnish. It stands up under the highest operating temperatures, provides better lubrication protection to cylinders, pistons, rings and other vital moving parts.

Switch to Sinclair RUBILENE and lower your costs. Whatever the make or age of your Diesel, whatever your lubrication problem, there's a RUBILENE or RUBILENE HD Oil that should meet your requirements. Call your Sinclair Representative for further information or write for free literature to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. There's no obligation.

SINCLAIR
RUBILENE OILS

George Edwards

tells how to keep a good man down–and out

At the American Power Conference in Chicago last March, Art Weston and I were talking about the increasing number of younger men presenting papers each year. Some of these men haven't been with their companies more than a few years, but they've moved up into some responsible spots. And this trend—a healthy one—is spreading in plants across the country.

Art recalled that in the old days giving a guy a promotion was a fairly simple process—the boss just picked out the fellow who'd been around the longest. But management has wised up to the fact that seniority doesn't guarantee ability to supervise others, and that the long-time employee is not necessarily a sharper thinker than a younger man.

I agreed that today's schemes for fitting the man to the job—efficiency ratings, fitness reports and oral examinations—have it all over the old seniority yardstick. But I think that the way some oral examinations are handled tends to drive a good man right out of the plant and into a competitor's arms.

There are ways—and ways—to conduct an oral examination. My good friend, Professor S J Mason, set up some ground rules a few years ago that are pretty sharp. Art got a real bang out of them and I think you will, too. Here they are:

A. Make sure that examiner appears smarter and trickier than examinee, thereby preserving his self-esteem.

B. Crush examinee as fast as possible, avoiding time-wasting problem of making a decision.

To accomplish this, follow these time-tested rules:

(1.) Before beginning, make examinee realize his whole future may rest on his performance. Put him in his place at the very start of the session.

(2.) Throw the *hardest* question at him first. This is important. If the first one is really tough, he'll be too rattled to think clearly on the others no matter how simple they may be.

(3.) Be grim and reserved when you speak to the examinee. It's effective, too, if you can make a humorous remark about his performance to anyone else in the room at the time.

(4.) Make him answer to conform to *your* thinking. Impose limitations and qualifications in each question. Idea is to complicate an otherwise simple problem.

(5.) Force him to make a trivial mistake, then let him puzzle over it as long as possible. Just *before* he has a chance to explain it, correct him yourself, with a sneer. (This takes real timing and a lot of practice, but it's worth the effort.)

(6.) If he gets in a hole, don't lead him out. Sigh and change the subject.

(7.) Ask him side questions such as, "Didn't you learn that the first year you were with us?"

(8.) Don't let him ask you to clarify a question. Tell him not to think out loud—you want the *answer*.

(9.) Every few minutes, ask him if he's nervous.

(10.) End the examination by telling him, "Don't call us, we'll call you."

Careful attention to these few and simple pointers will produce a truly successful examination of any man who has ability to handle a higher job, and would be a real asset to your company.

Keep yourself up to date . . .

To get more info on new equipment or FREE copies of latest bulletins

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Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here

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AIR CONDITIONING, VENTILATION

1 **Electronic air cleaners** with automatic operation are discussed in 2-p illustrated spec sheet 1460. **Includes capacity** data and dimensions. Westinghouse Electric Corp, Sturtevant Div, Hyde Park, Boston 36, Mass.

2 **Centrifugal precipitator** is described in 4-p bulletin 276. **Contains drawings**, photos showing construction and dimensions of unit. American Air Filter Co, Inc, 215 Central Ave, Louisville 8, Ky.

3 **Central station units** for controlled air conditioning are described in catalog 7558. Included is dimensional, performance and installation data. Young Radiator Co, Racine, Wis.

4 **Ventilating fans**, belt-driven models, are covered in 26-p bulletin UVS-104. **Performance tables, engineering data**, selection info included. General Blower Co, Morton Grove, Ill.

BOILERS AND AUXILIARIES

5 **Magnetic O_2 system** for steam power plants is discussed in 4-p data sheet 463-60. Features a full-page description of a recently installed system. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

6 **Automatic soot-blowing** control systems are subject of 16-p bulletin 1029. Gives complete descriptions and illustrations; includes physical dimensions, specs. Copes-Vulcan Div, Blaw-Knox Co, Erie 4, Pa.

7 **Condenser-tube** and tube-sheet-material selection, application, installation is subject of 44-p illustrated manual. Includes 12 spec tables. The American Brass Co, Waterbury 20, Conn.

8 **Steam generator** is described in 12-p catalog SB-59. Baffleless, pressurized two-drum water-tube packaged unit is illustrated, specs are included. Erie City Iron Works, Erie, Pa.

9 **Smokestacks** made of *Permaglas* are described in 8-p bulletin SS-202A. Illustrates design, application. A O Smith Corp, Box 584, Milwaukee 1, Wis.

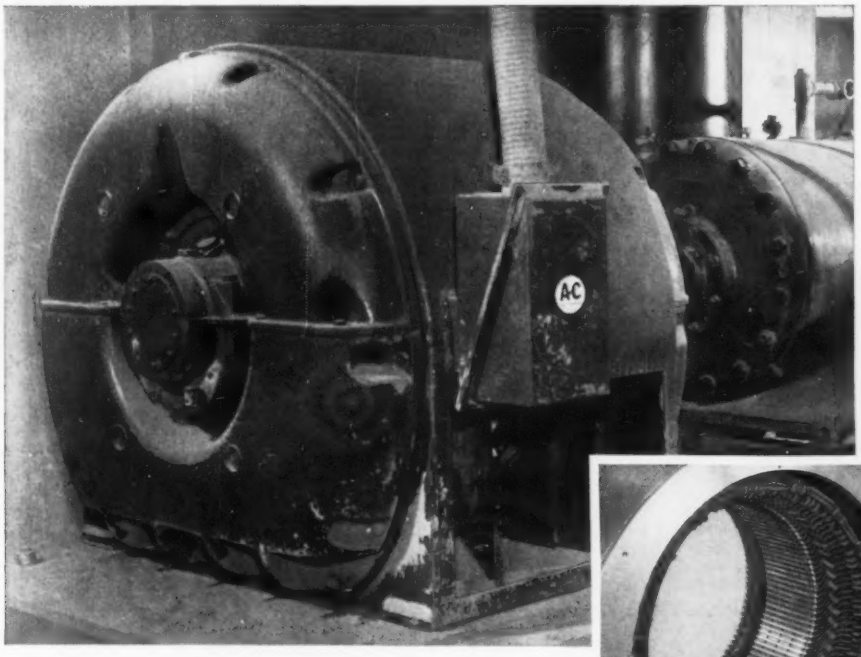
ELECTRICAL EQUIPMENT

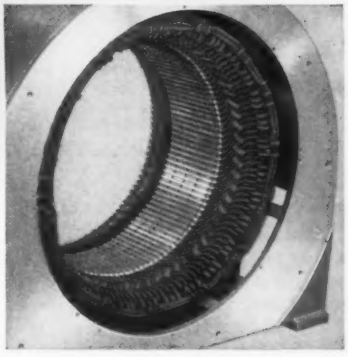
10 **Suspension insulators** and hardware, conductor-clamp selection tables are subject of 36-p catalog 1000 and 8-p catalog 1050. Included are scale drawings, charts. Delta-Star Electric Div, H K Porter Co, Inc, Lisbon, Ohio.

(*Continued on page 192*)

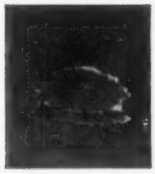
Super-Seal...

motor with void-free insulation

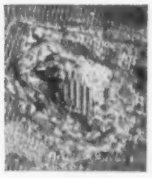




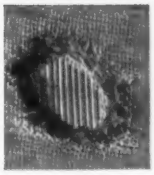
The motor that dust and dirt can't hurt



Silco-Flex Insulation



Polyester Mica Tape



Asphaltum Mica Tape

Note difference in abrasion! Insulation shown after sandblasting for one minute with 90-grit aluminum oxide and 100-psi air from distance of six inches.

REDUCE motor clean-up frequency and schedule this downtime at your convenience by using *Super-Seal* motors in areas where there's abrasive dust and clogging dirt. These motors —

Resist abrasion: Rubbery *Silco-Flex* insulation used in *Super-Seal* motors resists the cutting action of abrasive dust particles. Unlike conventional insulations, *Silco-Flex* insulation is flexible and resilient.

Completely sealed: *Super-Seal* motor insulation is sealed against contaminants. The vulcanized void-free dielectric barrier of *Silco-Flex* insulated stator coils even resists penetration by carbon black particles.

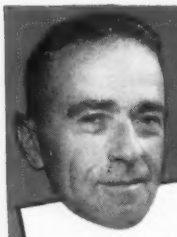
Combined with void-free *Silco-Flex* insulation are integrated mechanical features that make this motor especially suited to your toughest applications.

Get details! Call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Super-Seal and *Silco-Flex* are Allis-Chalmers trademarks.

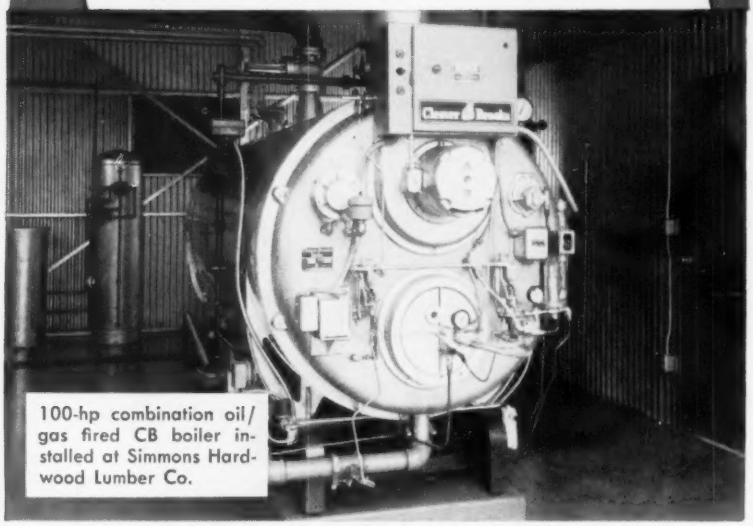
ALLIS-CHALMERS

A-5702



"40% SAVINGS ON FUEL,"
says ROY K. STILLWELL, Simmons Hardwood Lumber Co.
Los Angeles, California

"We are pleased to report that this entire automatic boiler installation has been successful in every respect. We find that fuel saving over our old installation is about 40%, which means that the installation will quickly pay for itself.
"Since we specialize in high-grade domestic and foreign hardwood lumber and pride ourselves on an outstanding dry kiln operation, we must have good high-quality steam. We are receiving exceptional results from our Cleaver-Brooks boiler."



100-hp combination oil/gas fired CB boiler installed at Simmons Hardwood Lumber Co.

For process steam economy . . .

Install a packaged CB boiler

CB boiler four-pass design with forced draft is the most efficient combination to transmit heat to boiler water. Forced draft blower provides correct amount of air for complete combustion, eliminates the need or cost of a high, expensive chimney. Combustion gases are forced at high velocity through the four passes, literally scrubbing heat from the flame. Result: lower fuel costs.

Five square feet of heating surface per boiler hp is another reason why CB boilers give you longer service life with less maintenance. Every CB boiler is guaranteed to operate at a minimum efficiency of 80%.

Each Cleaver-Brooks self-contained boiler is a complete package. Fully factory tested, it's ready for installation, service connections and operation. No make-ready delays . . . no extra parts needed.

A trained technician starts your CB boiler, adjusts it for your specific needs, and trains your attendant in care and maintenance.

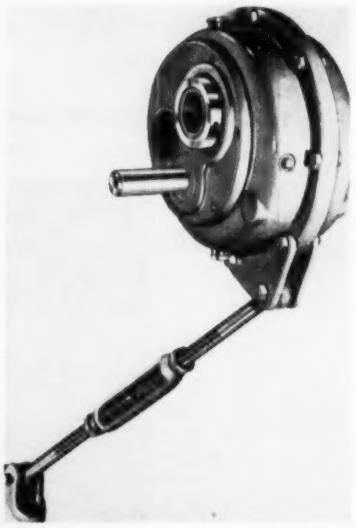
Available in 19 sizes, 130 models, 15 to 600 hp — steam or hot water, gas, oil, or combination oil/gas fired.

For more facts on the self-contained CB boiler, contact your dealer or write: Cleaver-Brooks Company, Dept. F, 301 E. Keefe Ave., Milwaukee 12, Wisconsin.

Cleaver Brooks®
ORIGINATORS OF SELF-CONTAINED BOILERS

Equipment news

Begins on page 150

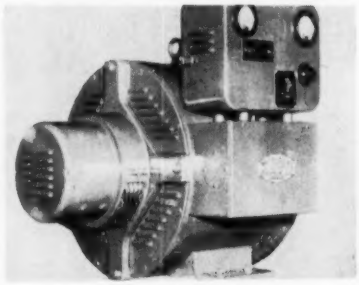


Shaft-mounted gear reducer

512 • Unit is said to eliminate need for motor bases, rails, supporting structures and flexible couplings. It provides a compact power-transmission unit, eliminates alignment problems, makes possible infinite speed ratios through use of variable-speed pulleys or by changing sheaves, sprockets or prime-mover speed, maker claims.

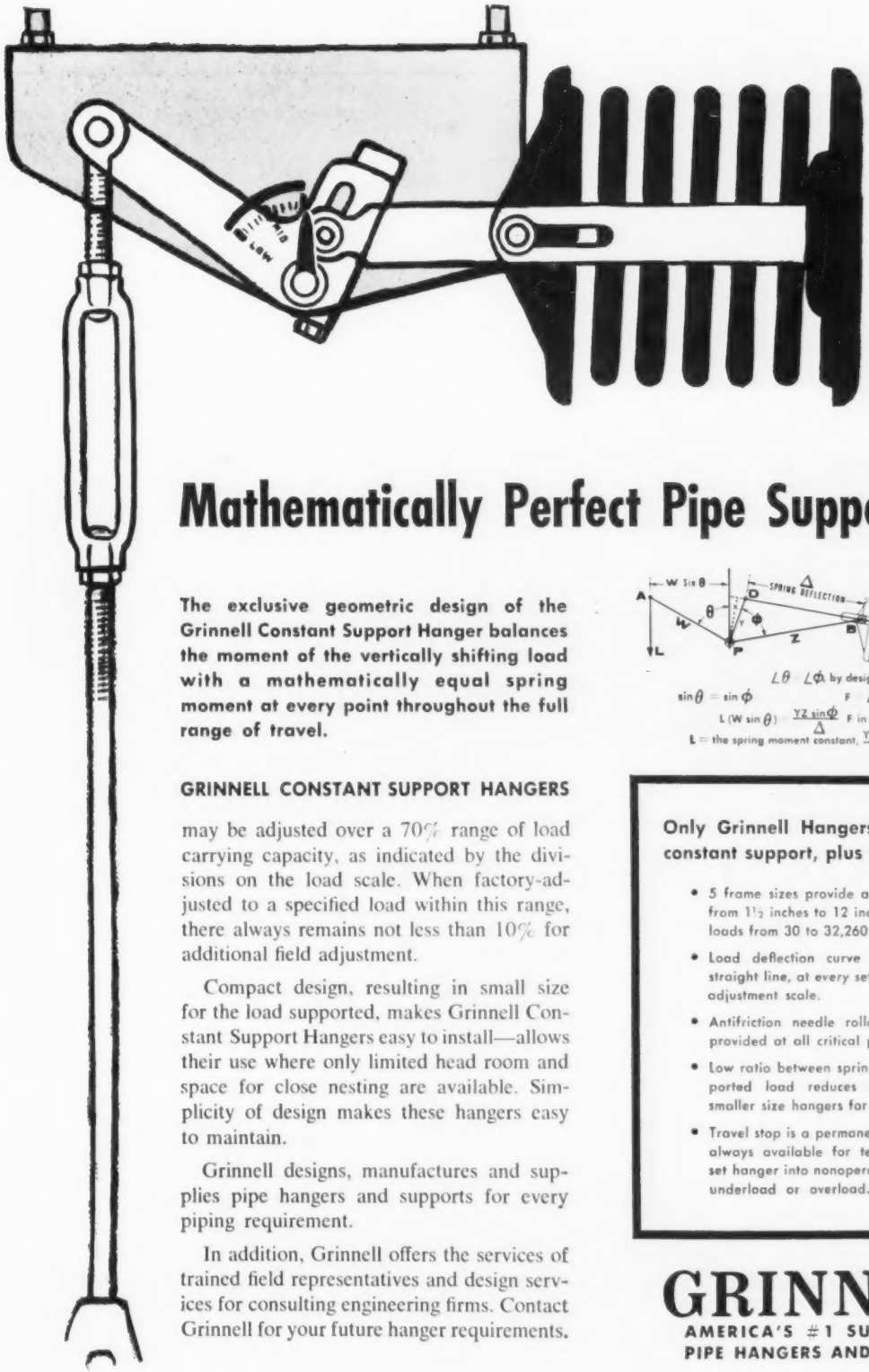
Single-reduction types are said to be 98% efficient and give 4.5:1 speed ratio, nominal. Double-reduction types are 96% efficient, give 14.7:1 speed ratio. Comes in fractional to 120 hp, 8 to 425 rpm.—*Lovejoy Flexible Coupling Co, 4896 W Lake St, Chicago 44, Ill.*

For more details on these items, use post cards p 157. Identify your request with item number.



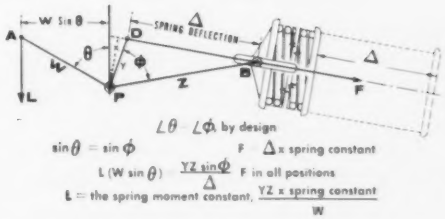
Electric generators

513 • Single-bearing 60-cycle close-coupled generator line is suitable for adaptation to commercial gasoline and diesel engines, maker states. De-



Mathematically Perfect Pipe Support!

The exclusive geometric design of the Grinnell Constant Support Hanger balances the moment of the vertically shifting load with a mathematically equal spring moment at every point throughout the full range of travel.



$\angle\theta \quad \angle\Phi$ by design

$\sin\theta = \sin\Phi \qquad F \quad \Delta \times \text{spring constant}$

$L\,(W \sin\theta) \quad \frac{YZ \sin\Phi}{\Delta} \quad F$ in all positions

L = the spring moment constant, $\frac{YZ \times \text{spring constant}}{W}$

GRINNELL CONSTANT SUPPORT HANGERS

may be adjusted over a 70% range of load carrying capacity, as indicated by the divisions on the load scale. When factory-adjusted to a specified load within this range, there always remains not less than 10% for additional field adjustment.

Compact design, resulting in small size for the load supported, makes Grinnell Constant Support Hangers easy to install—allows their use where only limited head room and space for close nesting are available. Simplicity of design makes these hangers easy to maintain.

Grinnell designs, manufactures and supplies pipe hangers and supports for every piping requirement.

In addition, Grinnell offers the services of trained field representatives and design services for consulting engineering firms. Contact Grinnell for your future hanger requirements.

Only Grinnell Hangers provide true constant support, plus these features:

- 5 frame sizes provide a range of travel from 1½ inches to 12 inches and support loads from 30 to 32,260 pounds.
- Load deflection curve is a horizontal straight line, at every setting on the load adjustment scale.
- Antifriction needle roller bearings are provided at all critical pivot points.
- Low ratio between spring force and supported load reduces friction, permits smaller size hangers for loads carried.
- Travel stop is a permanent attachment — always available for temporary use to set hanger into nonoperative position for underload or overload.

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
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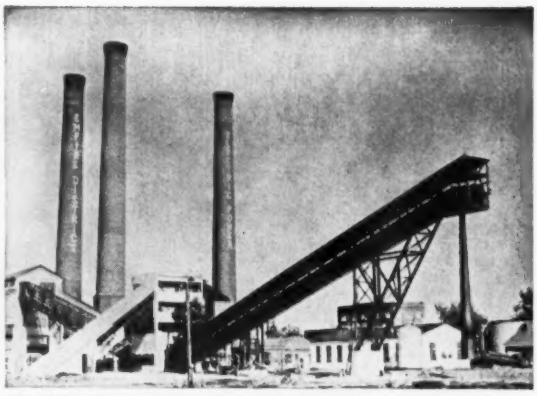
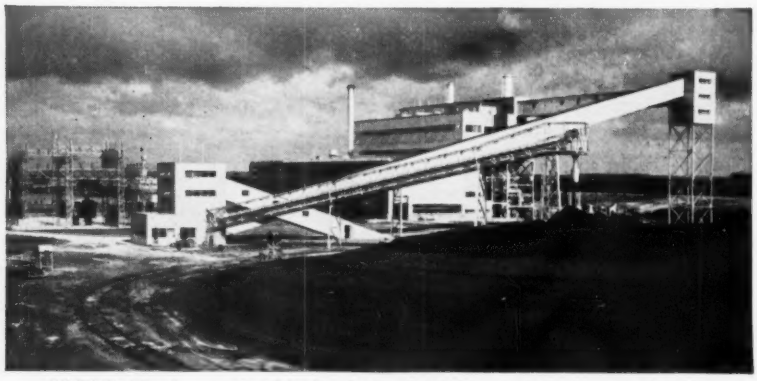
EARN EXTRA PROFITS IN SAVINGS



McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.



McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

—With Cost-Cutting

COAL-HANDLING SYSTEMS

Engineered for Your Plant

Are you paying "extra fare" luxury rates for that last ride your coal must take from the truck, car, or barge, to your bunkers?

Why pay more? Why risk breakdowns, when you can *save* extra "profits" and be sure of year-round efficiency.

McNALLY PITTSBURG Systems automatically handle more coal per dollar—minimum maintenance costs.

The men who know coal from the ground up will be glad to study your coal-handling problems with you. Mail coupon.

McNALLY PITTSBURG

"The Men Who Know Coal From The Ground-Up"

McNally Pittsburg Mfg. Corp., Dept. PO, Pittsburg, Kansas
Gentlemen: Send more information on your Coal-Handling Systems.

Name_____ Title_____

Company_____

City and State_____

Equipment news

Begins on page 150

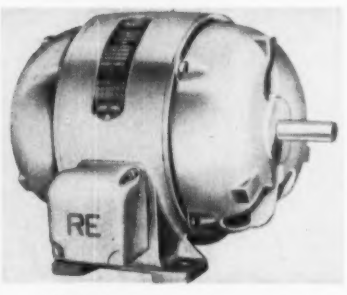
sign features include elimination of end ball bearing, with exciter armature being supported by main alternator bearing; reduction of length of mounting feet.—*Kato Engineering Co, Mankato, Minn.*

Indicating transmitter

514 • Compact unit is designed for pneumatic transmission of temperature measurement in ranges from 100 to 600 F, with spans of 100 and 200 F. Upper portion of conventional vapor-pressure thermal curve is expanded over a 4½-in. scale for greater sensitivity.

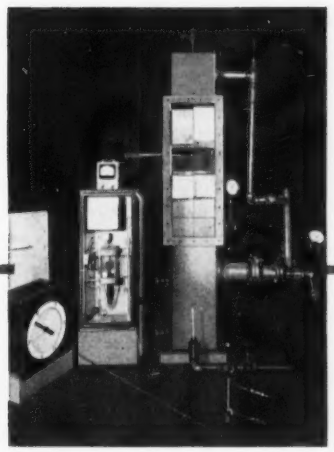
Vapor-pressure thermal system includes 4 x ⅜-in. bulb, 18-in. bendable bulb extension, adjustable union connection and polyvinyl plastic-covered bronze tubing over copper capillary.—*The Foxboro Co, Foxboro, Mass.*

For more details on these items, use post cards p 157. Identify your request with item number.

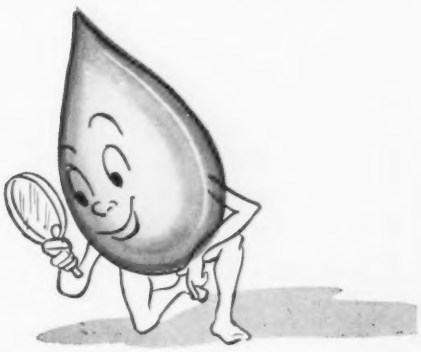


NEMA rerated motors

515 • Units have *NEMA* dimensions, specs, are for use in all industries. Electric motors come in hp ratings of ½ through 40, frame sizes



ALLIS-CHALMERS DEAERATORS



Pilot tray-type deaerator shown with continuous oxygen analyzer in test setup.

Looking for more effective deaeration?

Outdoor installation of Allis-Chalmers deaerator in southern chemical plant.

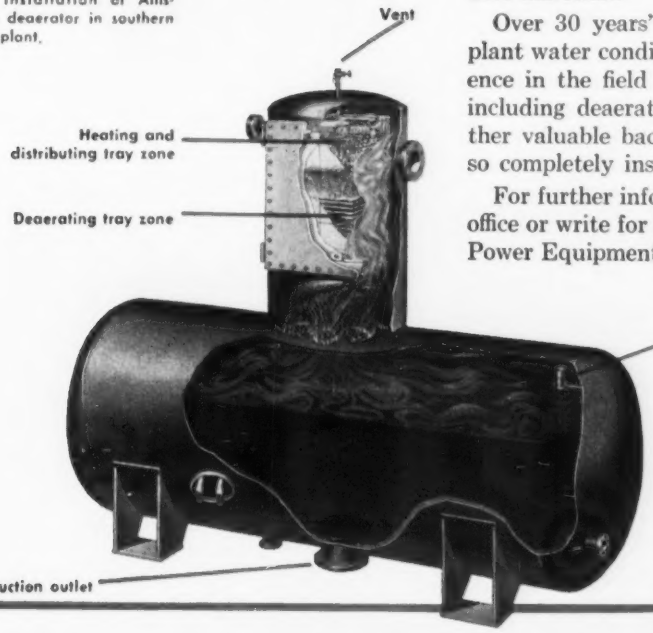
● If so — you'll be interested in the continuing research program at Allis-Chalmers to evaluate all factors in the design of deaerators.

This program includes the use of a specially built pilot deaerator with automatic oxygen analyzer and recorder. Operating factors and deaerating compartment design can be varied to study length of spilling edge of trays, heating area and method of flow. Results obtained with this setup are quickly translated into deaerators designed for optimum performance.

In addition to this continuous testing, metallurgical research is being done to select the most suitable materials.

Over 30 years' experience in the field of power plant water conditioning, and over 75 years' experience in the field of steam power plant equipment including deaerating-type condensers, provide further valuable background. No other manufacturer so completely insures deaerator performance.

For further information contact your nearby A-C office or write for Bulletin 28B8853, Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wis.



Cross section of tray-type deaerator shows water and steam flow.

ALLIS-CHALMERS

A-5674

The design work on all these new substations is going to be hard to handle with our present force.

Of course! They have enough to do handling routine duties. Why don't you call in PIONEER?

GIVE YOUR NON-ROUTINE OPERATIONS TO PIONEER

Design and Consulting Engineering Services

Pioneer has specialized in designing power plants for 56 years. It offers design service for fossil fuel, hydro and atomic plants. It will also assist in forecasting load growth, in site selection, in purchasing and expediting of equipment and in supervising construction. Pioneer's other services include substation, transmission and distribution studies and design.

Services in Regulatory Matters

Pioneer offers its services in all phases of Federal, State and Local regulation including the rate base, depreciation analysis, cost of service studies, market analysis, certificate proceedings and rate of return.

Corporate Services

Pioneer's services in corporate matters include business and management engineering advice; financial, accounting and tax counsel and insurance and pension plans and programming. It maintains a complete stock transfer, ledger and dividend disbursement service.

NEW!
On your letterhead, write for 40-page booklet, "Pioneering New Horizons in Power". Describes, illustrates Pioneer's engineering services, and corporate services, from financing to operation.

56 YEARS

Pioneer Service & Engineering Co.

231 South La Salle Street
Chicago 4, Illinois

Equipment news

Begins on page 150

132 through 326U, drip proof or totally enclosed fan cooled.

All-aluminum alloy frames are said to effect 25% weight reduction. —*Reuland Electric Co, Alhambra, Calif.*

Heavy-duty selector switch

16 • Unit features self-wiping contacts, will work well in any electrical installation requiring heavy-duty controls, according to manufacturer. Switch has no buttons or dials; built-in self-wiping feature is said to give long life, positive contacts at all times. Models are available with from 4 to 10 contacts.—*Sel-Set Machinery Corp, 290 Moyer Lane, Salem, Ore.*

For more details on these items, use post cards p 157. Identify your request with item number.

Sampling condenser

517 • Analysis of the mineral content of superheated steam is made possible by this stainless-steel unit. The shell- and tubular-coil type heat exchanger can condense one lb of steam per minute up to 3500 psi pressure and temperatures as high as 1100 F. Condensate, at 80 F, is analyzed to determine mineral con-

Maintenance–Saving Features You Can See

LUNKENHEIMER IRON BODY GATE VALVES

Machined guides . . . another Lunkenheimer exclusive, eliminate chatter and reduce wear . . . *true-solid discs* are unaffected by temperature variations . . . *Stemalloy® stems* assure longer stem thread life . . . *seat rings do not come loose or distort*—these are a few of the features that make Lunkenheimer Iron Body Gate Valves the most maintenance-free in the industry.

Ask your Lunkenheimer Distributor for a comparison test that will save you maintenance dollars, or write The Lunkenheimer Company, Cincinnati 14, Ohio.

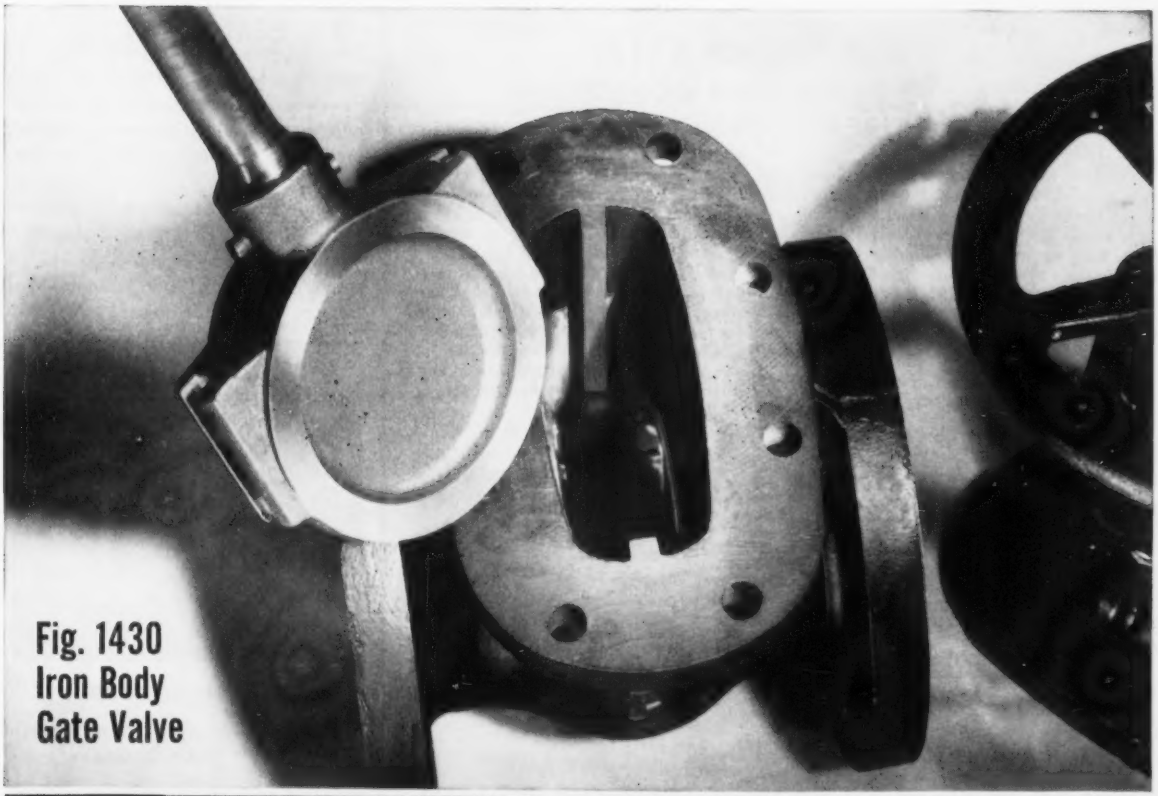
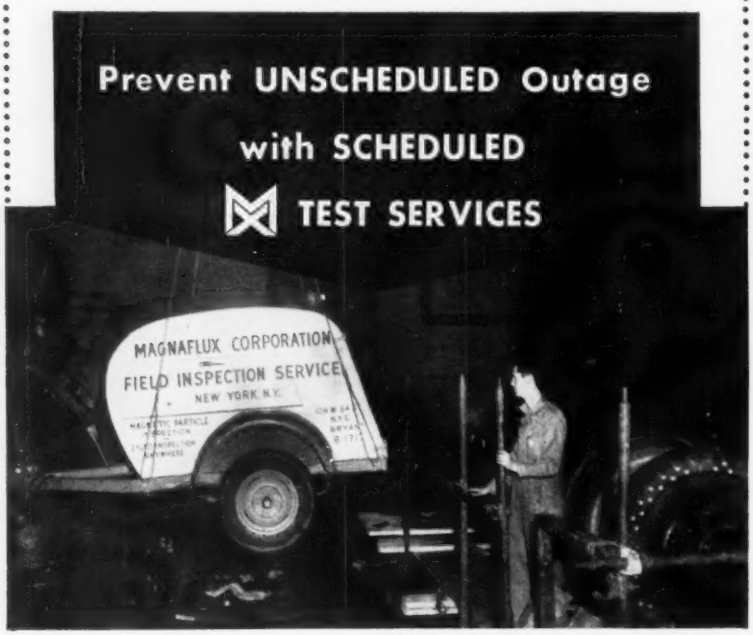


Fig. 1430
Iron Body
Gate Valve

LUNKENHEIMER QUALITY

LUNKENHEIMER®
THE ONE *Great* NAME IN VALVES



MX trailer inspection unit—a complete test and inspection shop on two wheels; can be set down with ease in any spot in your plant.

To be sure--

Call in **MAGNAFLUX**

NATION-WIDE COMMERCIAL INSPECTION SERVICE

Preventive maintenance in power plants is simplified when you make Magnaflux Field Inspection Service a regular part of your scheduled maintenance plan. Magnaflux field engineers, thoroughly experienced, use numerous exacting tests to spot future trouble quickly and reliably, saving your own people many hours of inspection time.

Magnaflux testing insures that equipment restored to service after overhaul is *fit for service*—a common-sense approach to reliable operation.

This inspection means less risk of unplanned shutdowns. Fatigue cracks and corrosion often don't show up under other test methods. Magnaflux methods detect even the tiniest flaws. Complete, detailed reports, including photographs, records and drawings where necessary, are furnished after each plant call. This guides future maintenance operations, and helps spot potential troubles during scheduled outages.

Magnaflux Commercial Inspection Plants in 16 cities make an experienced "pool" of trained field engineers available to you on a 24-hour basis. When you need this service, your Magnaflux team is as close as your telephone. This nationwide service gives you all the benefits of a specialized, fully trained crew on a stand-by basis—*but on your payroll only while they are working for you.* When you schedule your next overhaul, also schedule the Magnaflux Inspection Service to give any degree of inspection you may require. Also, we have a folder on "Power Plant Maintenance". Write, if you'd like a copy.

MX crews are equipped for all magnetic and fluorescent tests, penetrant tests, eddy current, X-ray, gamma-ray, ultrasonic, electrostatic and brittle-coating stress inspection.

Write for full details now—
OR CALL ANY OF THE COMMERCIAL INSPECTION PLANTS SHOWN BELOW.

MAGNAFLUX CORPORATION

7324 West Lawrence Avenue, Chicago 31, Illinois

HALLMARK OF QUALITY IN TEST SYSTEMS

Mineola, L. I., N. Y. Pioneer 7-3220	Philadelphia, 33 BAldwin 3-5500	Detroit 11 TRinity 3-4343	Dallas 35 FLeetwood 2-2626
Newark 4, N. J. HUmbolt 3-1235	Pittsburgh 36 TUxedo 2-3448	Indianapolis 18 Liberty 7-1303	Houston 21 WAlnut 3-9169
E. Hartford, Conn. BUtler 9-2737	Cleveland 15 HEnderson 2-0727	Chicago 39 EVergiade 4-1561	Oakland 8 OLympic 8-0201
Bridgeport, Conn. EDison 6-2113	Cincinnati 23 MUlberry 1-6436	Los Angeles 22 RAymond 3-8961	Van Nuys STate 5-8640

Equipment news

Begins on page 150

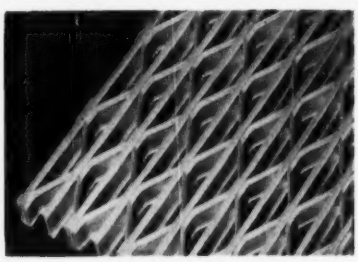
tent of steam in electric generating stations operating at high pressures and temperatures.—*Technical Engineered Products, Inc, 116 Washington Ave, Kearny, N. J.*

Portable heavy-duty pump

518 • Hydraulic-motor pump develops up to 10,000-psi pressure and weighs only 65 lb, according to maker. Units can be used with hydraulic benders, pipe pushers, knockout punches or for pressing, pushing or pulling bushings, bearings, shafts, pump pistons.

Pump is said to deliver 80 cu in. of oil per min, is driven by a standard ½-hp single-phase 60-cycle 1750-rpm 110 to 120-v motor.—*Tal Bender, Inc, Milwaukee 2, Wis.*

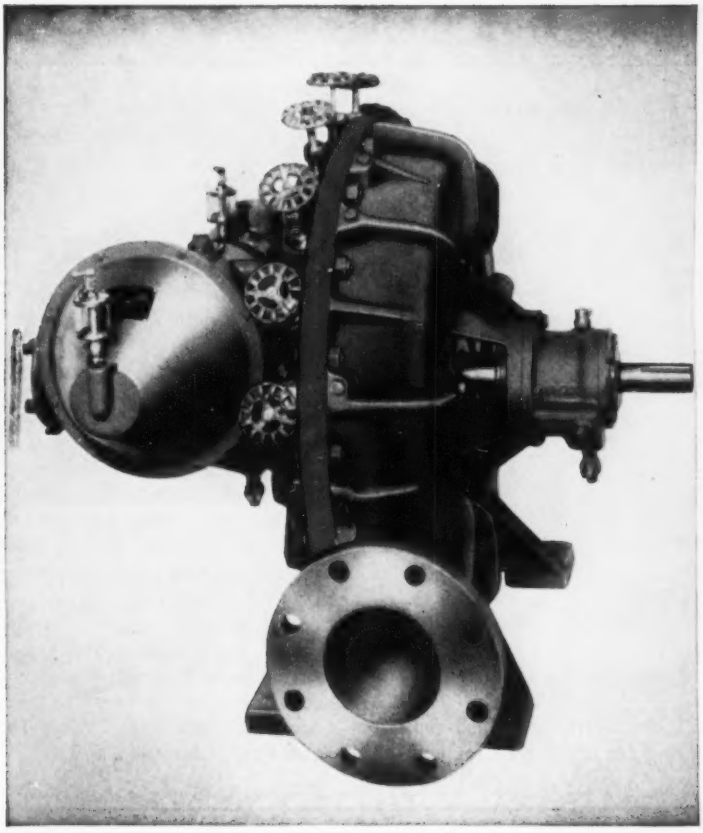
For more details on these items, use post cards p 157. Identify your request with item number.



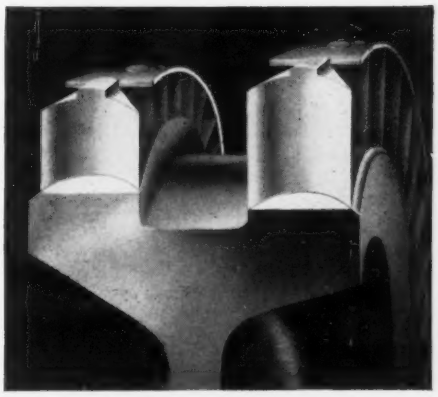
Aluminum grating

519 • Said to be especially desirable in power plants because of nonsparking features, new grating is made of crimped bars permanently roll locked into bearing bars. Unit is solid, one-piece and rattleproof according to manufacturer.—*Kerrigan Iron Works Inc, 274 Madison Ave, New York, N. Y.*

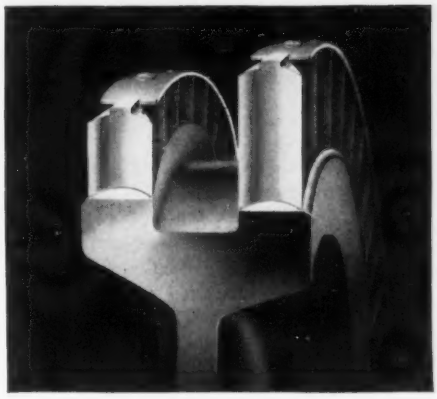
(*Continued on page* 168)



This is the reliable Coppus Turbine furnished with either type of wheel



Wide bucket "L" type wheel



Regular type wheel

Top performance in all COPPUS TURBINES

Both the regular type wheel or wide bucket "L" type wheel give you Coppus proven high quality and low maintenance cost. The "L" type wheel is the new development for use where low water rate is essential.

Coppus "Blue Ribbon Turbines" earned their fine reputation right on the job. Users vouch for their top quality performance and their low maintenance cost.

In the words of the supervisor of a large chemical company: "Coppus turbines require so little maintenance that a person would starve to death, if he depended on it for a living."

Proven features of *all* Coppus Turbines:

- Turbines rated close to your hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbines.

COPPUS ENGINEERING CORPORATION
165 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER

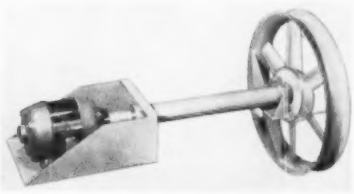
COPPUS "BLUE RIBBON" TURBINES

More **equipment news**

Wind power plant

520 • Wind-driven power package consists of a six-kw wind generator, battery bank and a standby diesel generator, and is designed to provide electrical power in remote, isolated areas. Assembly operates on a fully automatic basis.

The complete plant is mounted on a 33-ft steel tower. It can withstand wind velocities in excess of 100 mph. A special "storm-stop" feathers blades when wind exceeds 45 mph. During long periods of low wind velocity the load is carried by batteries, which are recharged by the generator.—*Nordberg Mfg Co, Milwaukee 1, Wis.*



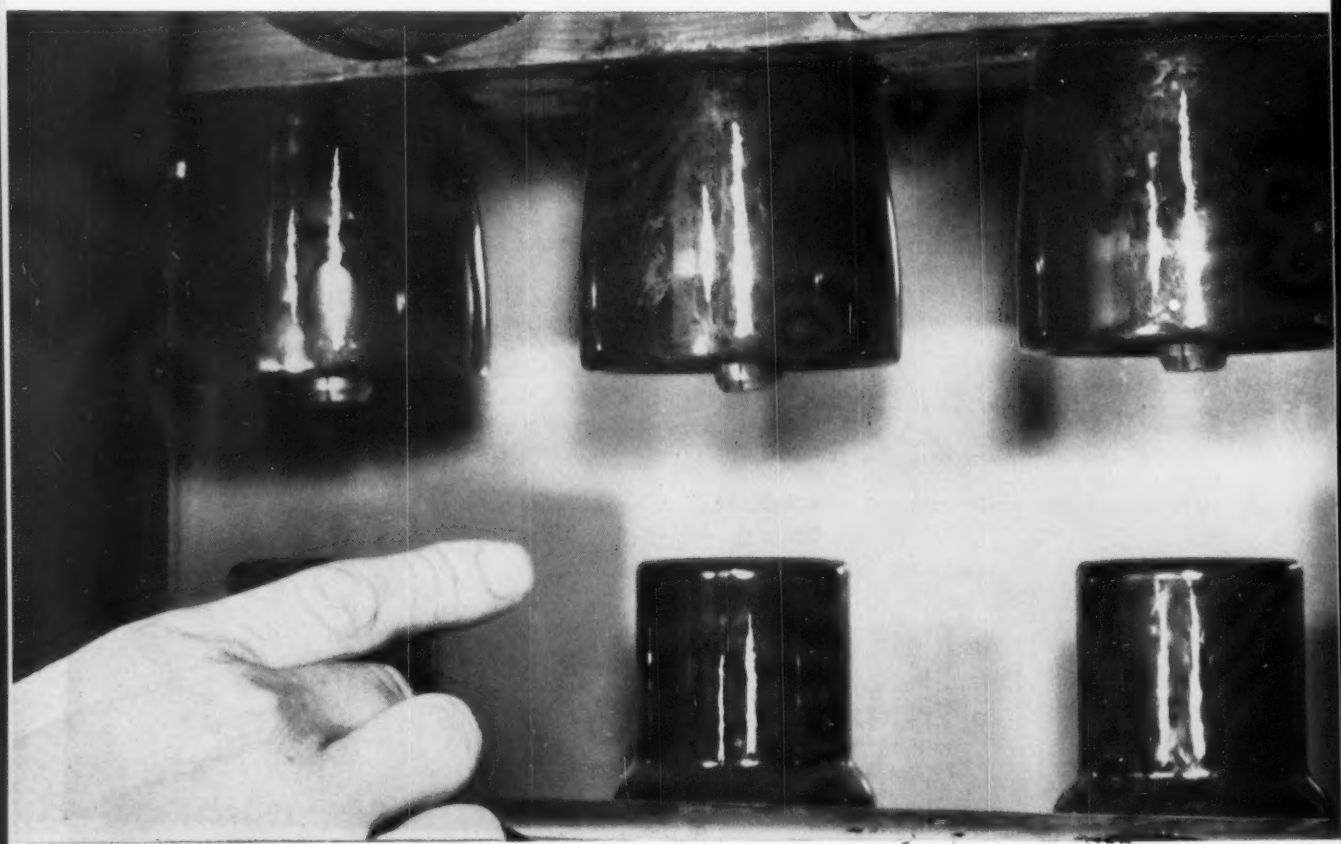
Extended-shaft fan

521 • Direct-drive extended-shaft orifice ring fan is designed for operations where motor must be kept out of air stream: exhausting gases or corrosive fumes, circulating high-temperature air for drying. Aerodynamic blade design combines high pressure characteristics with low noise level. Fan sizes range from 24 to 42 in.—*Chicago Blower Corp, 9863 Pacific Ave, Franklin Park, Ill.*

Coating inhibits corrosion

522 • Liquid-Neoprene protective coating has a built-in primer. Advantages of the rubber coating are said to include ease and flexibility of application; long-lasting resistance to weathering, chemical fumes, salt spray and corrosion creep; resistance to impact and abrasion.

Coating adheres to steel, bronze, aluminum, stainless steel and galvanized iron as well as concrete, wood, rubber, according to manufacturer. —*Charleston Rubber Co, Stark Industrial Park, Charleston, S. C.*



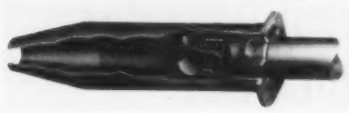
Begins on page 150

Ultrasonic decontaminator

523 • Footwear-decontamination bath keeps radioactive soils, other industrial contaminants from being tracked from "hot" places or into sterile areas.

Equipment "scrubs" away hot particles, can remove radioactive soils from rubbers, galoshes and plastic foot sheaths. The equipment consists of a transducerized tank fitted with a treadle to support user's weight.

Circulation of fresh water to a level of one in. above soles of feet is said to be insured by an overflow drain connected to the waste sewer. If no sewer is available, waste can be filtered and water recirculated to tank.—*Atomic Accessories, Inc, 244-02 Jamaica Ave, Bellerose, N. Y.*



Larger dust collector

524 • Dust collector uses 24-in. tubes. Unit was designed for collecting abrasive, hygroscopic and high-moisture-content materials, can provide economical installation where collection efficiencies below 85% satisfy requirements, according to manufacturer. Operating economies are also said to be possible with 24-in. unit where 85 to 90% of particle size is coarser than ten microns, even for efficiencies up to 95%.—*Research-Cotterell, Inc, Bound Brook, N. J.*

Automatic coupling

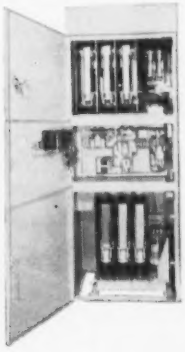
525 • Unit eliminates heat problem because metallic shoe conducts heat away from drum, according to manufacturer. Automatic heat transmission is said to eliminate heat checking and cut generated heat almost two-thirds. Other features are elimination of torque fade and greater heat dissipation on high-inertia jobs. —*O S Walker Co Inc, Rawson Coupling Div, 1000 Rockdale St, Worcester 6, Mass.*

For more details on these items, use post cards p 157. Identify your request with item number.

New isolating switch in Westinghouse *AMPGARD** high-voltage starters insures personnel safety

Exclusive new isolating switch with mechanical interlocks in Westinghouse AMPGARD High-Voltage Starters insures the highest degree of personnel safety. Isolating switch cannot be opened under load . . . access to high-voltage compartments is prohibited unless isolating switch is open . . . isolating switch cannot be closed and motor started unless high-voltage compartment doors are latched closed. This switch is featured in both the front accessible 30″-deep and the front-rear accessible 60″-deep starters.

Westinghouse AMPGARD magnetic starters are available for squirrel-cage, wound-rotor and synchronous motors ranging to 5000 volts, 3000 hp.



For complete information about these new Westinghouse AMPGARD high-voltage starters, call your nearby Westinghouse representative. Or, write Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pa. J-22103

*Trade-Mark

POWER-UP starts with CONTROL

YOU CAN BE SURE...IF IT'S Westinghouse

RAMBLINGS ON INSTRUMENTATION

(Our advertising manager, a beleaguered soul, has asked that we doff the mantle of restrained intimacy with which we approach these "Ramblings" and, for crying out loud, put some punch in this particular column. Regular readers may be shocked but, it is hoped, will sympathize with the pressures that beset us. So they want an ad with some socko, hey. Here goes:)

New Hays Universal Recorder Acclaimed As "Not Bad!"

Those who saw it for the first time couldn't believe it! That's right . . . the group that first saw the new Hays recorder at a trade show preview simply couldn't believe that anyone could be silly enough to bring a new recorder into a world already glutted with recorders.

However, when they were told that the new Hays Universal Electronic Recorder has the new, streamlined "sheer look," their indifference changed to apathy!

Furthermore, when one hardboiled plant superintendent heard that the new Hays recorder has three basic interchangeable receiver units, he said "*Ummh.*"

That's not all! When this group actually saw with their own eyes how an almost unlimited variety of variables can be recorded—all in one basic recorder—they turned to one another and murmured, "What's for lunch?"

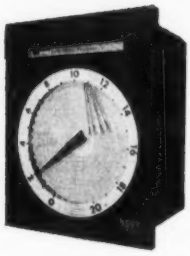
(At this point we discovered we were at the wrong show . . . the National Pickle Packers Convention, as a matter of fact. Some mix-up about dates.)

As it turned out, the pickle packers actually *were* intrigued by the recorder's new Hays Constant Voltage Unit for potentiometer applications . . . especially when they learned that this little Rock of Gibraltar has a stability of ±0.05% on a 20% supply voltage variation. And, no standard cells, batteries, sleight-of-hand or electronic tubes are involved!

In case you missed the National Pickle Packers Convention, here are the facts. The three interchangeable units are:

Slidewire Receivers—for potentiometer and resistance bridge applications.

Differential Transformer Receiver—for recording flow, level, pressure, temperature or input motion, using standard Hays transmitters. Sensitivity here is rather impressive, even to a pickle-packer . . . ±0.1% of *transmitter* differential transformer core motion.



As displayed at the National Pickle Packers Convention.

Mechanical Receivers—for direct recording of pressure and temperature using bellows, bourdons and gas-filled temperature system.

We also have a number of accessories for each electronic receiver. These range from adjustable switches and retransmitting slidewires to 300° indicators and retransmitting differential transformers. A maximum of two integrators or two pneumatic transmitters or controllers can be hung on the chart plate.

To show how this bric-a-brac can be combined, let's start with a flow receiver with slidewire, add a differential temperature (resistance bulb) receiver with slidewire, feed outputs of these two slidewires into another slidewire receiver, throw in an integrator, and *voila!* . . . a BTU Recorder with flow record and integration plus Delta T record and BTU record—all in one case. Interested? We'll send you details.

Hays' Give-Away Department

- Universal Recorder Bulletin, 57-1190-47
- Universal Recorder Specification Sheet, 58-1223-41
- Universal Recorder Bank Carton

Phil A. Sprague

President

THE HAYS CORPORATION • MICHIGAN CITY, 3, INDIANA

Marmaduke

Continued from page 140

to maintain a pH value of 8.0 to 8.5 by adding soda ash to the brine solution. But the brine rapidly turned acid. This often happened within 24 hours after the units were drained, cleaned and charged with a fresh brine solution.

"The high acid content was corroding the galvanized coil surfaces, casings and fan wheels. Labor costs for cleaning and recharging the units were also high. Not only that, but the large consumption of salt and lichromate had management kicking.

"Several experts in the water-and-brine-treatment field had been called in. They made laboratory tests, wrote reams of fancy reports, but couldn't lick the problem. What had everyone buffaloed was why the pH dropped from 8.5 to a low of 6.0 within a few hours.

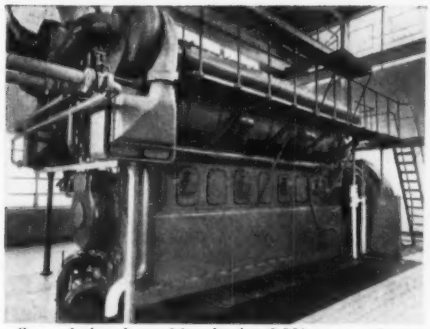
"After listening to their troubles, I asked Bill if I could walk through the main storage rooms for a look-see.

"'Well,' he answered, 'everyone else has taken a crack at our problem. Don't see why you can't.' Just then the plant manager walked in. Bill introduced me and told him I was interested in helping them.

"'That's good news,' the manager answered good naturedly. 'Since we're paying out barrels of money for corrosion and dumping expensive chemicals into that brine, I'll make you a deal. If you can solve our problem which stumped all the experts, I'll write out a nice little check for $500 for your trouble. How's that strike you?'

"That sounded good but I could see he thought I'd come up with a zero.

"'Now you're talking my language,' I answered, as the boys crowded around. 'I learned years ago that common horse sense is all a guy needs to operate machinery so long as he knows his basic science and feels at home in a plant. Trouble is that most so-called experts get sidetracked by a psychological block. Soon as they hear the problem, they start thinking of all the complicated theories some egghead learned second-handed from a textbook and lectured them on in college. Now those theories are good, but after being crammed full of them most guys don't use common sense in applying them. And theories are no good if you don't



One of the three 16-cylinder LSV gas engines at Kindersley. Note the neat, compact arrangement of this 4380 hp unit.

In Canada's largest gas engine generating plant . . .

COOPER-BESSEMER SUPERCHARGED LSV's!

At the new Kindersley plant of Saskatchewan Power Corporation . . . three supercharged Cooper-Bessemer four-cycle gas engines total 13,140 reliable horsepower.

These engines, each driving a 3000 kw generator, deliver long-awaited capacity and dependability to the western area of the Provincial System. Now, with 9000 kw capacity plus Cooper-Bessemer efficiency, Kindersley meets power demands with ease and is in a position to offer new industry assurance of adequate, economical electric power.

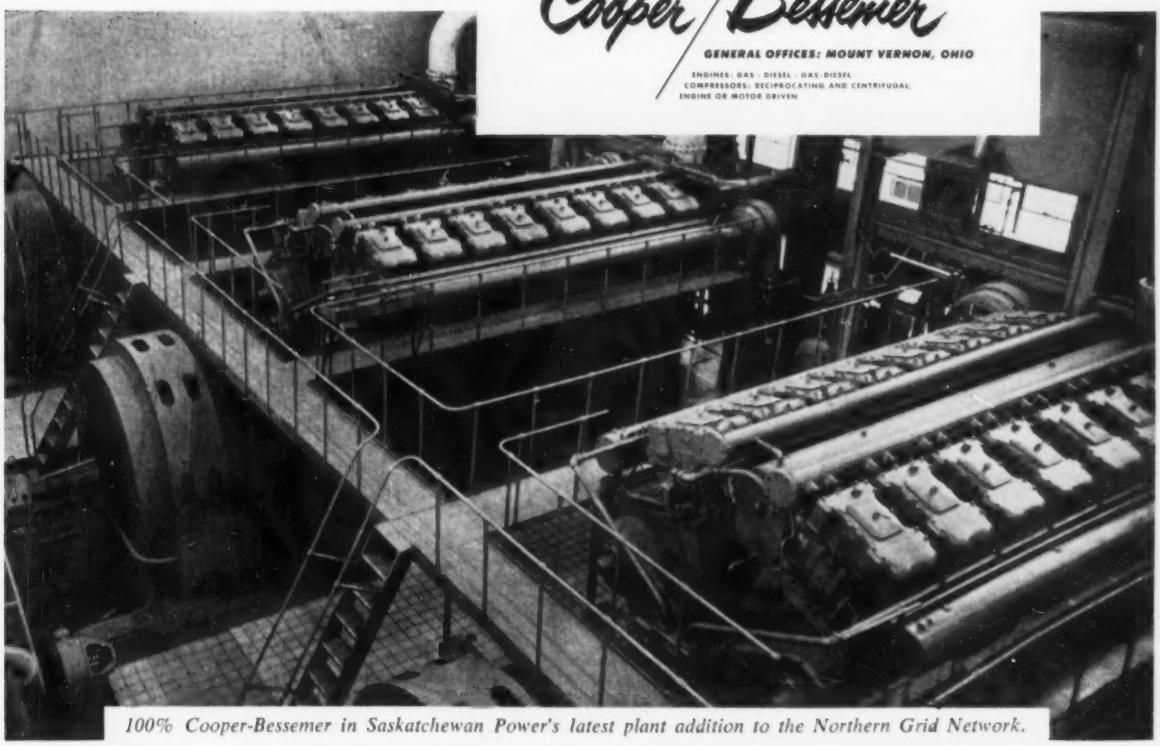
An outstanding engine feature here is a unique turbo-expander system of air temperature control, permitting fuel economy previously unheard of with a closed cooling water system. This Cooper-Bessemer system also eliminates the need for frequent adjustment and greatly simplifies fuel balancing despite an extreme range of ambient temperatures.

If you would like detailed information as to the operational cost economies of this station, write to The Cooper-Bessemer Corporation, Mount Vernon, Ohio.

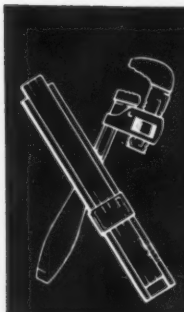
Cooper Bessemer

GENERAL OFFICES: MOUNT VERNON, OHIO

ENGINES: GAS - DIESEL - GAS-DIESEL
COMPRESSORS: RECIPROCATING AND CENTRIFUGAL
ENGINE OR MOTOR DRIVEN



100% Cooper-Bessemer in Saskatchewan Power's latest plant addition to the Northern Grid Network.



YOU GET EVERYTHING THE ENGINEER & MAINTENANCE MAN ASKED FOR IN THIS NEW LIGHT WEIGHT, COMBINATION STEAM TRAP!

Fast warm up through rapid removal of both air and condensate up to 10° F. of saturation.

Continued discharge of air and condensate at steam temperature.

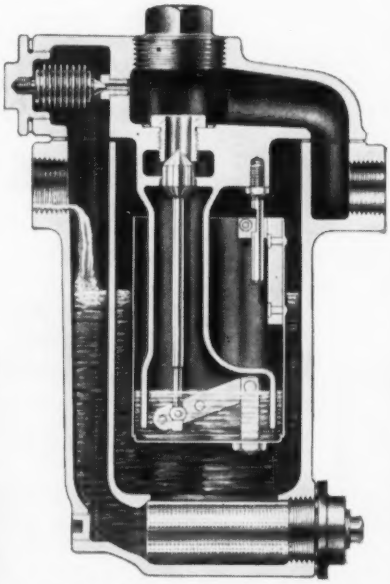
Built-in filtration of solids

Easy access to all working parts

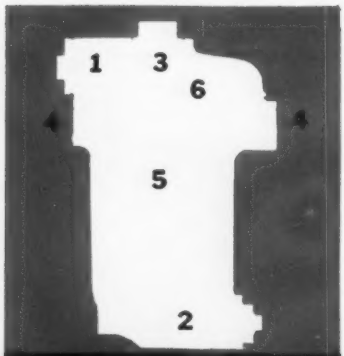
Interchangeable main orifice

Light enough to be supported by line

Step by step steam traps have been improved, making them compact, lighter and more efficient, easier and faster to service. Now Wright-Austin has incorporated all these advances into one of their proven vertical bucket-type traps—the new 500-C series. Write for literature.



500-C Series—For ½" to 2" pipe lines; Pressures to 150 PSIG; Capacity to 30,000 lbs./hr.



1. Monel thermostat air by-pass
2. Monel strainer
3. Valve seat accessible through inspection plug
4. Straight-through pipe connections
5. All operating parts stainless steel
6. Working parts removed with cover

For fast and continuous heat in:

Unit heaters
Hot water heaters
Steam mains
Laundry equipment
Platen presses
Heat exchangers
Cylinder dryers
Jacketed Kettles
Sterilizers
Evaporators

WA 1894 **WRIGHT-AUSTIN COMPANY**
3245 WIGHT STREET • DETROIT 7, MICH.

Marmaduke

Continued from page 170

mix them with a little horse sense.'

"'That's a nice little speech,' came back the manager with a smile on his kisser. 'But it kinda puts you on the spot. Now if you can't solve our pH problem that has stopped everyone else, I guess you're in the same class with the so-called experts.'

"'Let's go to your main storage rooms,' I answered. 'I've yet to see any kind of power plant equipment that had me buffaloed for long.'

"By then we had the crowd of plant people with us. Word had gotten around that some wise-guy marine engineer put himself on the spot. Everyone had been tearing his hair out and here I was sticking my neck out. They acted like they were going to a 3-ring circus.

"Soon as we stepped into the first storage room, a gasoline-powered fork-lift truck roared past us.

"'What's that truck doing in here?' I asked the manager.

"'Why, it operates in these rooms several hours a day, bringing in and removing cold storage stores. Why do you ask?'

"Hearing that I turned and walked out of the room, saying over my shoulder, 'Let's go back to the office and I'll tell you.'

"My audience had a puzzled look on their faces. They stared at me as if I were nuts, but they followed the manager, Bill and myself back into Bill's office. I sat down to a desk, propped up my feet and lit a cigar. You could hear a pin drop. They were waiting like some ancient multitude waiting to hear the words of their prophet.

"'You serious about having the answer?' eagerly asked the manager, while I leisurely blew smoke rings and collected my thoughts.

"'Sure thing,' I said. 'You can't have pH control if you're going to run that gasoline-powered truck in and out of those storage rooms.'

"'What?' he yelled. "'Why not?'

"'Because,' I told him, 'the products of combustion of hydrocarbon fuels are CO_2, CO and various aldehydes. All of them are easily soluble in water. So your brine coolers are acting as excellent air washers in removing the acid gases from the air in your storage rooms.'

"'Oh yeah?' asked the manager in

THE PEACEFUL ATOM

...can propel a ship one year without refueling

New Study Shows Nuclear Power May Be Practical and Economic for Merchant Ships

Some gray dawn in the early 1960's a heavily laden supertanker will shoulder her way through the steep Atlantic swells to a landfall in Delaware Bay. She'll be homeward bound for Philadelphia, 19 days out of Kuwait with nearly 40,000 tons of oil.

FOR SHIPS LIKE THIS...

No more dependent on thousands of tons of payload-stealing fuel oil, tomorrow's ships will range worldwide trade routes without refueling.

In the last twelve months she will have made eight trips to the Persian Gulf hand running. Now at last she is due for her annual refit... *and her annual refueling.*

Competitive at sea

A nuclear power plant for a ship of this type was the subject of a study recently completed by Atomics International for the Maritime Reactors Branch of the Atomic Energy Commission. Costs of building and operating a vessel powered by an Organic Moderated Reactor were compared with those for an oil-burning ship—a typical modern supertanker of some 38,000 deadweight tons.

Total costs for the OMR tanker, depreciated over 20 years, were only moderately higher than for today's conventional ship. But costs for oil-burners are on their way up, with steadily rising fuel prices seen from now on—whereas the cost trend for the OMR is downward, as nuclear technology is improved. An OMR tanker has greater cargo capacity because its fuel takes up little space. And it needs refueling less than once a year.

Bigger payloads, longer hauls, faster turn-arounds—this is the new pattern of operation. Shipowners can begin plans right now, for the Organic Moderated Reactor promises to put the atomic merchant ship on a sound commercial basis.

Versatile on land

The same features that make the OMR applicable for seagoing use are also in its favor for central power stations ashore. The basic simplicity and safety of this system point to economic nuclear electricity for many areas of the world today.

Plans are already underway to build an OMR plant in Piqua, Ohio, which will increase the city's electrical generating capacity by 12,500 kilowatts. Another OMR power station is planned for a Latin American country.

First OMR now in operation

All this stems from the results being achieved with the Organic Moderated Reactor Experiment, conducted by Atomics International for the Atomic Energy Commission. The Organic Moderated Reactor Experiment is being carried on at the AEC's National Reactor Testing Station in Idaho to establish the basic engineering data for this type plant. Atomics International is also operating the Sodium Reactor Experiment, a nuclear power project for the AEC. Another power reactor concept, the Advanced Epithermal Thorium Reactor, is under study for the Southwest Atomic Energy Associates. AI research reactors are now operating in Japan, Germany, Denmark, and the United States. Another is being built for Italy. ATOMICS INTERNATIONAL, P.O. Box 309, Canoga Park, Calif. Cable address: ATOMICS.

...ATOMIC ENGINES LIKE THIS

Al's Dr. A. B. Martin shows on this OMR tanker model how the compact power plant will free thousands of cubic feet of fuel space for revenue-producing cargo.

ATOMICS INTERNATIONAL

A DIVISION OF NORTH AMERICAN AVIATION, INC.

PIONEERS IN THE CREATIVE USE OF THE ATOM

One of two Plants at Canajoharie, N. Y.

BEECH-NUT LIFE SAVERS, INC.

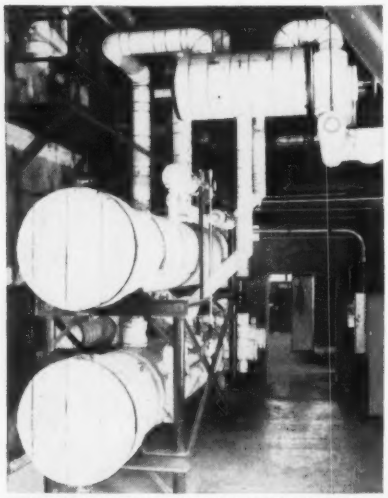
LIKE **Frick Refrigeration**

And use ten big Frick ammonia compressors, plus numerous condensers and coolers, in their famous plants at Canajoharie, N. Y.

For process work, air conditioning, and cold storage, Beech-Nut Life Savers find Frick Refrigeration an indispensable aid.

Recent installations made by Mollenberg-Betz Machine Co., Frick Sales-Representatives at Buffalo.

Let us aid you in applying modern refrigeration and air conditioning to your business. Estimates cheerfully furnished, without obligating you.

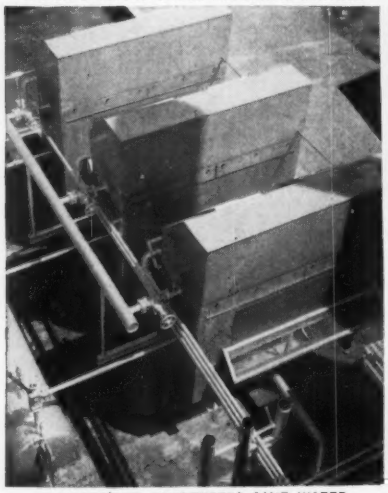


WATER CHILLERS UNDER AUTOMATIC CONTROL

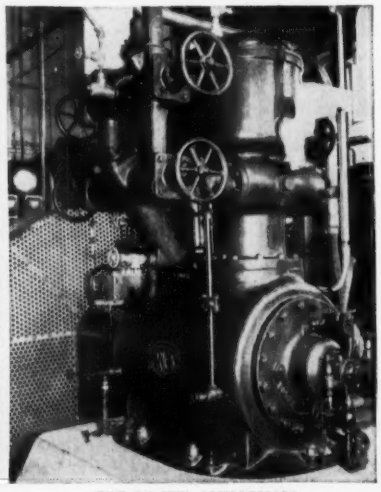
DEPENDABLE REFRIGERATION SINCE 1882

FRICK CO.

WAYNESBORO, PENNA., U.S.A.



EVAPORATIVE CONDENSERS SAVE WATER



ONE OF TEN COMPRESSORS

Marmaduke

Continued from page 172

astonishment, cutting me short, 'and how can you prove that?'

"By a common horse-sense test that any grease monkey can make,' I answered.

" 'And how's that?' he asked, giving me a fishy look.

" 'Just take a strip of litmus paper,' I continued, 'and you'll find it turns a bright blue when contacting a known alkaline solution. Hold it a few inches from the exhaust pipe of the lift truck. It'll turn a bright pink if there's any acid.'

" 'Mr Surfaceblow is right,' piped up my friend Bill. With that he sent one of his men to the stockroom for a piece of litmus paper. We went back to the storage room where the lift truck was still scooting about. Sure enough, the paper turned a bright pink.

" 'That may prove you're right,' said the manager finally. 'But where do we go from here? Does that mean we can't use lift trucks to horse these stores around? Hell, we'll have to go out of business.'

" 'Nope,' I told him. 'All you have to do is add a water exhaust to the lift truck so the exhaust blows through the water. And you can also keep the trucks' operation in the cold-storage rooms to a minimum.

" 'By golly, Marmy's right again,' piped up Bill, excitedly slapping me on the back. 'I can rig temporary water exhausts on our two lift trucks in a few hours. We'll drain the brine systems, and by tomorrow we'll know if we're out of the woods, before the *Dorothy McSquid* shoves off.'

"No one said a word, but went back to their work quietly. My solution was too sudden—and too simple. It left them speechless.

"Next afternoon, Bill came aboard and asked me up to the manager's office. 'Your horse sense paid off, Mr. Surfaceblow,' he said, handing me the $500 check. 'You were right about so-called experts running into a psychological wall when they don't combine a little horse sense with their theory."—STEVE ELONKA

TRANE FAN

We in Trane Co's engineering office always enjoy reading about Marmy's unusual experiences.

L HERBSTREITH, *LaCrosse, Wis.*

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Another is a questioning attitude . . . a frame of mind that habitually asks (before the job is placed in the shop for fabrication): "Have the pre-fabricated sub-assemblies been so planned that the field work is minimized and simplified as much as possible?" Highly skilled Midwest piping engineers carefully analyze every job with this question in mind.

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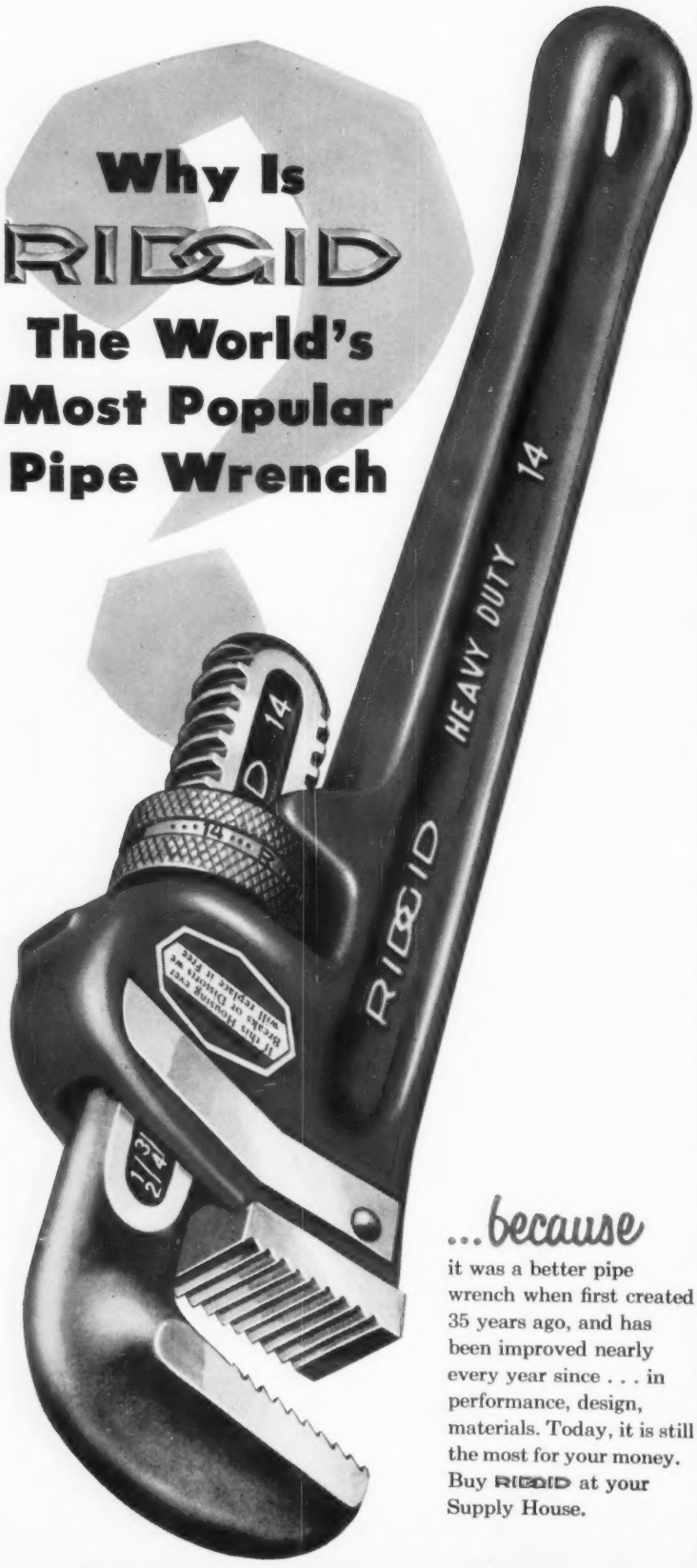

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The Ridge Tool Company, Elyria, Ohio, U.S.A.

Boiler plant

Continued from page 111

two loops. The heating loop comprises the h-p hot-water generator, circulating pumps, flow and return piping. The boiler circuit comprises steam leg to the generator, water leg from there to system circulating pumps and back via the feed manifold into the boilers. The two loops have a common leg—between the h-p hot-water generator and the circulating pumps.

Steam goes directly from the boiler-house manifold to the Yankee dryers. Several-step pressure reduction brings 100-psi steam to the dryers. These have been equipped with a blow-through system which draws steam and condensate from the dryers into a separator, maintained at 80 psi. A thermo-compressor raises the steam pressure and reinjects it into the dryers while existing pumps return condensate to the boiler house.

A larger deaerator, operated at 25 psi, replaced the old one in the boiler house. Condensate and the negligible amount of needed makeup enter the deaerator and are transferred to the h-p hot-water generator by the make-up pump.

A water-level controller regulates rate of feed into the generator. However, since this unit must take up system expansion (the deaerator has limited storage space), there must be a continuous feed into the generator —roughly equal to condensate coming from the dryers and irrespective of specific volume variations in the h-p hot-water heating system. These, due mainly to Permacel-LePage's process requirements (three-quarters of a mile away), can cause a water level variation of more than 1-ft in the generator. The controller absorbs this variation and still admits condensate return from the dryers without flooding the deaerator.

Condensate returning from the dryers has a temperature of about 310 F. Since existing equipment wouldn't permit a deaerator pressure increase beyond 30 psi, this introduced one of the drawbacks of a steam system into this formerly closed system — condensate flashing from 100 to 25 psi had to be absorbed. The boiler house had no use for this heat so the problem was solved by providing for supercooling the condensate at the separator outlet. It's

planned to pipe the condensate through additional air coils spotted ahead of the h-p hot-water air coils on the paper-machine hoods.

Before the conversion, system maintenance outside the plant, apart from repacking valves, was nil. Maintenance within the boiler plant was minor. No boiler tubes were replaced and, despite very inexpensive water treatment, no scale formed in the boilers. The circulating pumps are repacked approximately every two years. No shaft sleeve has ever been replaced and the pumps were opened only once—to change impellers when the system was expanded.

In addition to simplifying power-plant operation, the conversion has upped overall efficiency. Water temperature leaving the generator is only a half-degree below saturation temperature corresponding to boiler steam pressure. This pressure has been cut back 10 psi (to 185 psi), yet flow temperature remains at 381 F. Boiler efficiency has gone up because of (1) removal of the baffle covering part of the heating surface and (2) improvement in internal boiler circulation.

Heavy start-up loads are still picked up with little or no effect on the boiler plant. Maintenance, including boiler-water treatment, still remains simple and inexpensive.

Modernization

Continued from page 84

the various locations would eliminate the savings realized through efficiency. It would also be necessary to train personnel to operate and maintain rectifiers.

So, we decided to continue the use of motor-generator sets; two 500-kw and two 400-kw machines were selected. Each machine was allowed about 25% of its capacity for normal future plant expansion. Our new system insures continuity, since the secondary switchgear bus is divided in half, load-wise, and a solid copper bus link connects this split. Circuit breakers of necessary load and interrupting capacity are installed on either end of the bus and carried to one side of a different switchgear. If there is a failure of any machine, the main bus link can be removed, the circuit breaker closed and each

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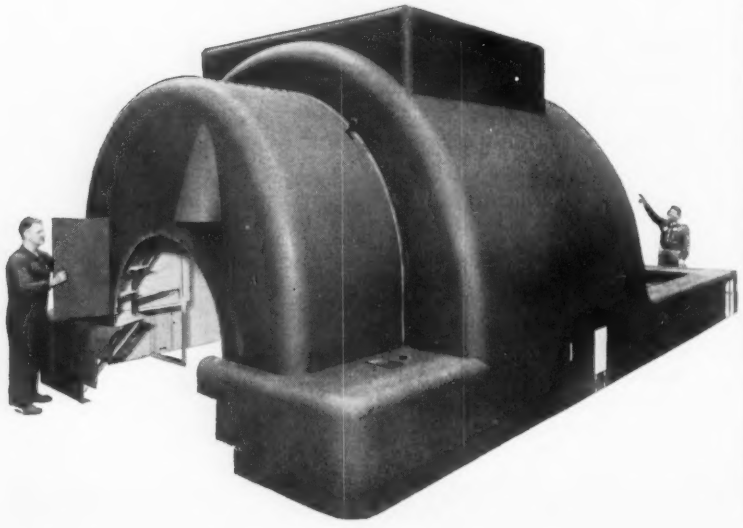

Modernization

Continued from page 177

half of the load can be thrown onto another machine, sketch, p 84.

This installation has also brought dividends. Immediately after it was installed the plant was flooded and one machine was completely inundated. It was weeks before we could put this machine back in service. Within three days after the water had subsided, the switchgear was dried out, copper link removed, circuit breakers closed on the tie feeders, and service restored on the dc bus. This was an extremely important maneuver as this unit fed the plant powerhouse. If service hadn't been restored, the entire plant would have shut down.

Two largest buildings house the majority of the 550-volt productive system. So, modernization of this system began there. Load dictated three 1500-kva, 13.8/.575-kv transformers which were placed in strategic locations outside of the buildings nearest the load centers. This saved valuable production space, produced good voltage regulation and saved copper because of shorter feeders. The three transformers supply their local areas with necessary power, but each is tied to another transformer's secondary switchgear so in event of failure the important equipment can be fed from another source. Cost of this protection is low because each transformer is within 200 ft of the others. A feeder runs the length of both buildings and extends up the risers with duplicate circuit breakers having common ties on the secondary side. This insures continuity for the capacity of the remaining feeder breakers to the most important production functions for this system. When additional transformers are installed to replace older units that cannot be paralleled, we plan to expand this system to include these transformers also.

Final system to plan was an emergency system for the key equipment that had to run despite service failures. We did this by installing a separate transformer whose primary was fed by another utility company with a different generating source. The secondary of this unit has automatic throwover switches; in event of failure of the normal power supply, these switches operate within seven

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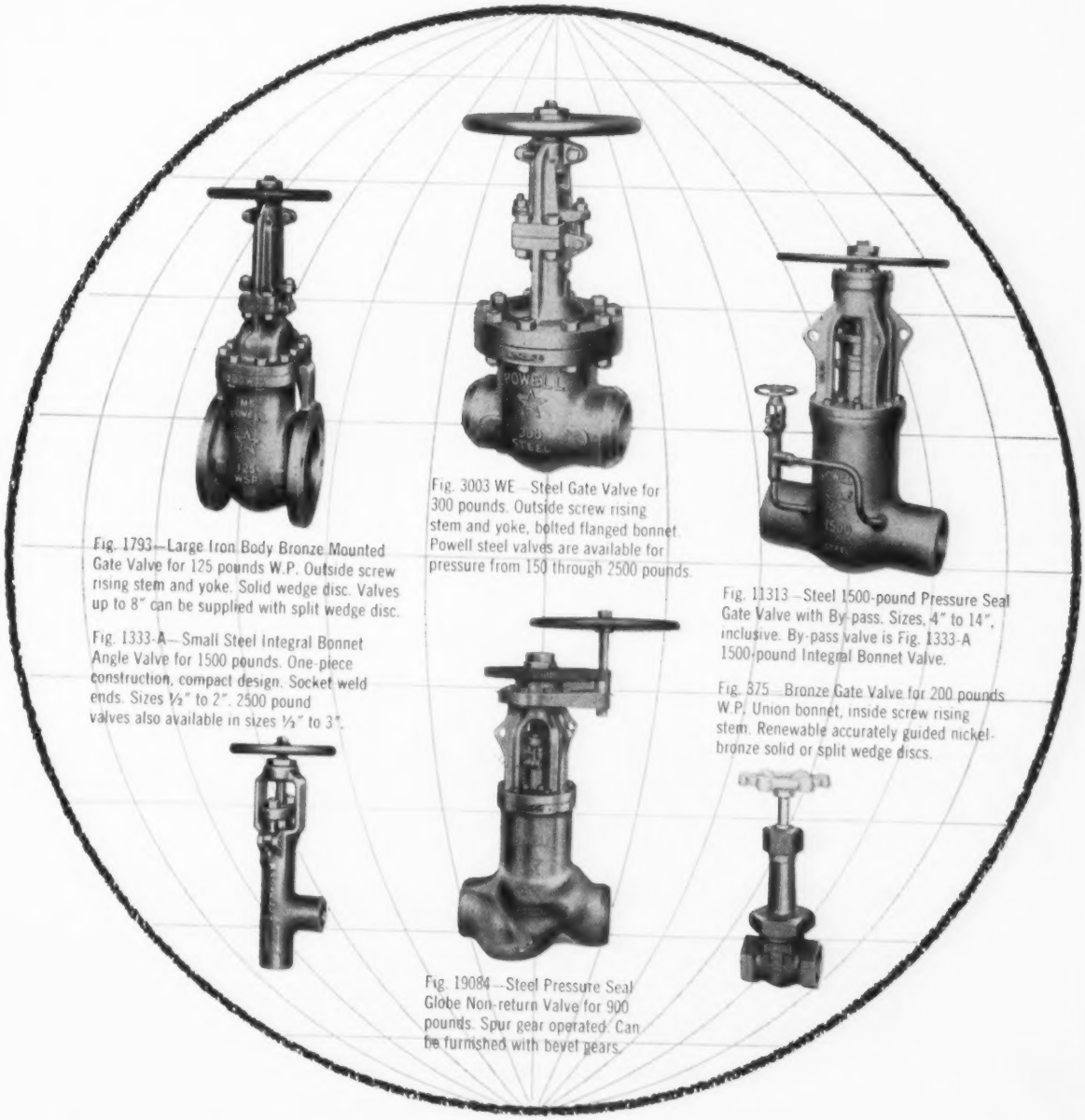

Fig. 1793—Large Iron Body Bronze Mounted Gate Valve for 125 pounds W.P. Outside screw rising stem and yoke. Solid wedge disc. Valves up to 8" can be supplied with split wedge disc.

Fig. 1333-A—Small Steel Integral Bonnet Angle Valve for 1500 pounds. One-piece construction, compact design. Socket weld ends. Sizes ½" to 2". 2500 pound valves also available in sizes ½" to 3".

Fig. 3003 WE—Steel Gate Valve for 300 pounds. Outside screw rising stem and yoke, bolted flanged bonnet. Powell steel valves are available for pressure from 150 through 2500 pounds.

Fig. 11313—Steel 1500-pound Pressure Seal Gate Valve with By-pass. Sizes, 4" to 14", inclusive. By-pass valve is Fig. 1333-A 1500-pound Integral Bonnet Valve.

Fig. 375—Bronze Gate Valve for 200 pounds W.P. Union bonnet, inside screw rising stem. Renewable accurately guided nickel-bronze solid or split wedge discs.

Fig. 19084—Steel Pressure Seal Globe Non-return Valve for 900 pounds. Spur gear operated. Can be furnished with bevel gears.

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Modernization

Continued from page 178

cycles and supply power from the emergency source to the necessary equipment. The 25-kva-transformer units are distributed throughout the plant for emergency lighting so personnel can be removed with safety from the building in event of power failure. These lighting units also give plant protection men sufficient light to make their rounds at times when normal power is shut off, such as on weekends, holidays, etc.

Thousands of fluorescent fixtures have been installed to improve lighting conditions throughout the plant. They are supplied by standard 25-kva 3-phase 4-wire transformer units comprising a primary circuit breaker transformer and a lighting panel. Throughout the high-bay areas in the mill room, we installed 400-watt mercury-vapor lamps. This lighting cuts through the carbon-black dust and, since the lamp has internal reflectors, the intensity of light is maintained. In other types of lighting, where external reflectors were used in these areas, the sulfur fumes discolored the reflectors and settlement of carbon-black dust further lowered the efficiency of the reflectors. A maximum of about 5 ft-c was all that could be obtained after several months with an input of about one watt per sq ft. The mercury-vapor installation, however, at about one watt per sq ft produces and maintains an intensity of from 30 to 45 ft-c, depending on the type and color of walls, ceiling and equipment.

Lansdale heater

Continued from page 80

scribed by the turbine manufacturer.

Contact heating in each stage assures maximum deaeration of the feedwater. Noncondensable gases cascade back to the main condenser.

The 4-stage Lansdale heater will give about a 1% improvement in overall station heat rate over that obtained with a conventional closed-heater cycle. This largely comes from the zero terminal temperature difference characteristic of open heaters.

Study of a 75-mw turbine plant running on a 1450-psig, 1000/1000-F

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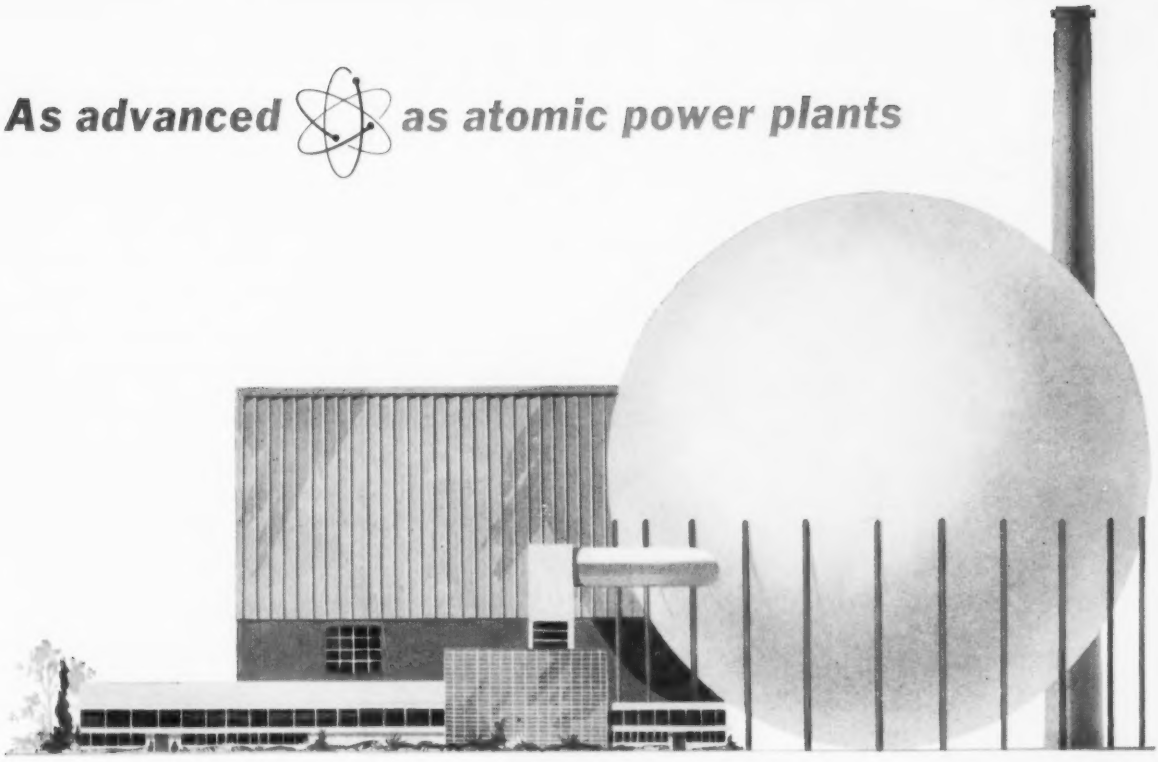

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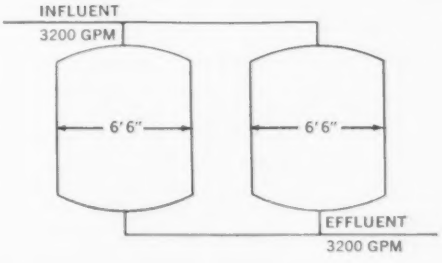

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Lansdale heater

Continued from page 180

reheat cycle with eight bleed points showed significant savings for the K-F tower heater compared to using conventional closed heaters. Sum of savings in installed costs and capitalized operating savings amounted to over $12 per kw installed capacity. This included pumping horsepower, building space, engineering, installation, piping, insulation, heater, overall cycle heat rate improvement and construction time.

A single stage K-F test heater has been running for over one year with gratifying results.

Generators

Continued from page 93

on a recorder equipped with alarms to warn of excessively high gas or winding temperatures.

Field temperature is determined by measuring the field resistance. This resistance increases with increased copper temperature. By carefully measuring field resistance at a known temperature (for instance after a unit has been out of service for several days) you can compare the operating resistance with the standard by applying a factor for resistance variation with temperature.

You can get a rough approximation of field resistance by dividing field volts by field amperes. However, the voltage drop across the brushes of the field collector rings may cause some error. A more accurate method uses a separate set of brushes with low voltage drop to measure the field resistance between collector rings. This measurement is then converted to a temperature value and recorded on a chart. There should be an alarm to warn against excessively high temperatures.

Generator rated capacities are usually based on a cool-gas inlet temperature of not more than 40 C. Coolers are sized to attain this with water temperature to the coolers not more than 95 F. Maximum temperature limits are usually set as follows: stator, 100 C; rotor, 125 C. Temperature alarms are set 10 or 15 C below these limits.

Even though hot-spot temperatures are considerably below the maximum

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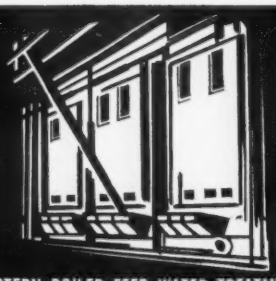

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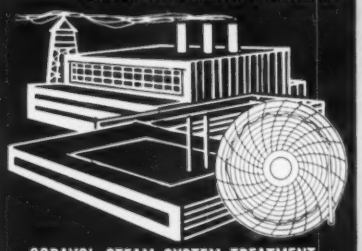
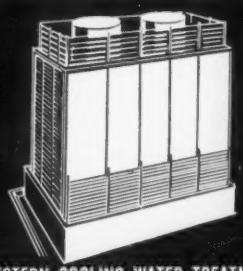


CORAVOL STEAM SYSTEM TREATMENT



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Generators

Continued from page 182

allowed, manufacturers generally recommend using full hydrogen pressure at rated generator loads or above. This is based on the theory that indicated temperatures may be lower than those at other spots in the winding where temperature-feeling elements are not installed. Raising the hydrogen pressure provides a margin of safety.

Generator temperatures can be held steady by regulating the quantity of cooling water used. There are several good reasons for doing this: (1) Steady temperatures limit movement of the copper coils with respect to the iron core. Copper expands about 40% more than iron, so some part of the winding must move with respect to the laminated steel stator of the rotor core as temperatures rise and fall. This may cause wear and premature deterioration of coil insulation; or if coils are wedged tightly enough to prevent movement, "necking" or deterioration of the copper may result. To reduce this effect, manufacturers often recommend preheating the field of large units before increasing speed. This also lessens temperature strains in the rotor metal.

(2) Temperature changes may also cause hydrogen loss when system is under automatic pressure control. As temperature falls, pressure drops, and the control adds hydrogen to maintain the pressure. When next the temperature and pressure rises, the overpressure relief valve may lift, releasing hydrogen. This may be repeated with each temperature cycle.

Hydrogen consumption. For minimum hydrogen use, eliminate all leaks. Even with a completely tight system, some hydrogen is lost because sealing oil absorbs the gas.

Before adding gas to the system, use dried air or carbon dioxide for a pressure test. Test all joints, packings, gaskets, etc with a soap solution to locate leaks. When every possible leak has been stopped, run a 24-hr pressure maintenance test at maximum system design pressure. Then calculate the amount of leakage from the observed pressure drop.

Of course, the best final proof that the system is tight is the need for only a small amount of hydrogen makeup. Keep a record of hydrogen bottles used. A sudden increase in

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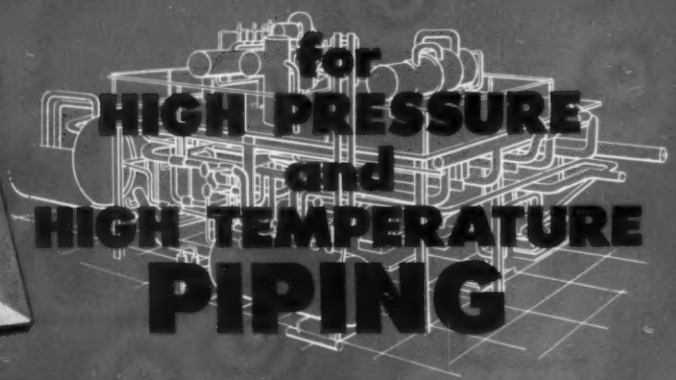

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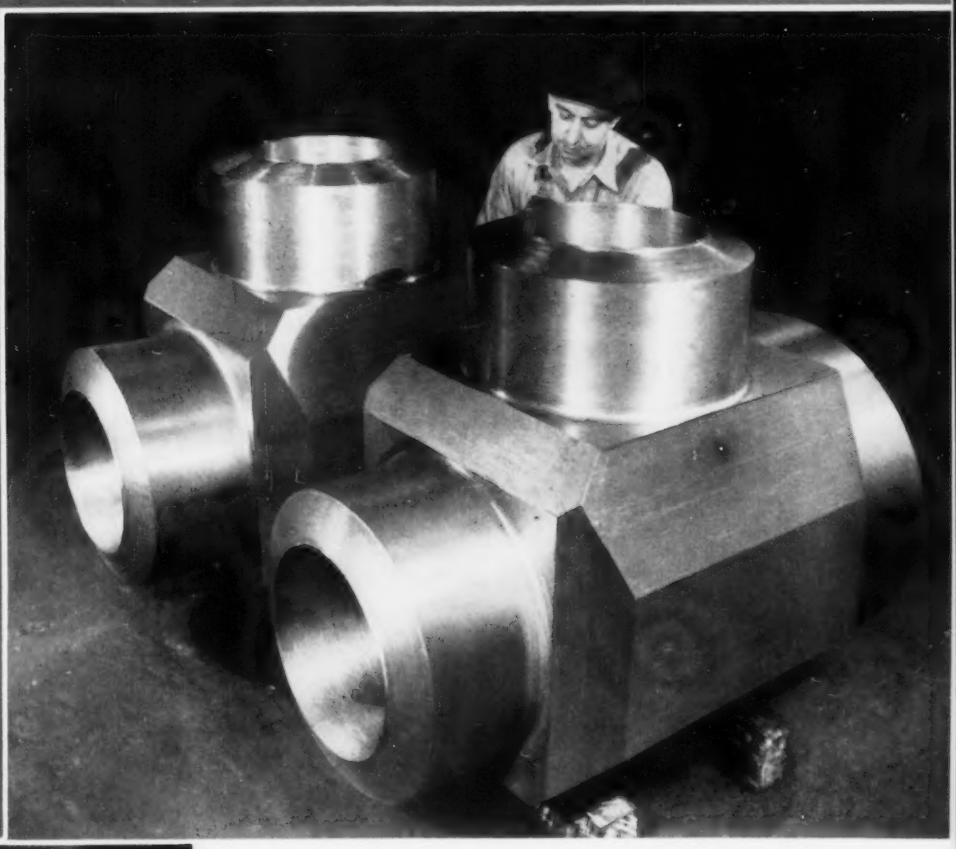
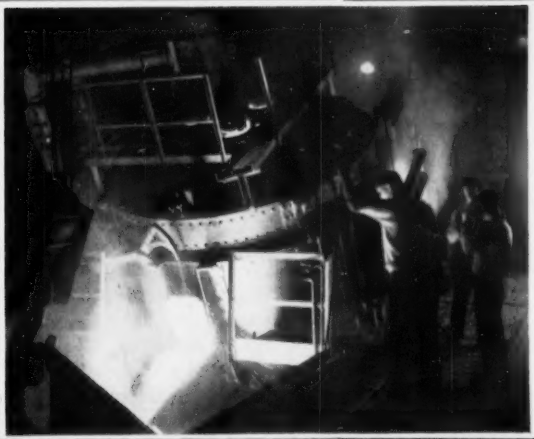
ELLS





Experienced Furnace Crews at Mesta operating the Most Modern Equipment produce the High Quality Alloy Steels required to make High Pressure—High Temperature Pipe and Fittings.

Chrome Molybdenum Alloy Steel Tees forged, machined, rigidly inspected and tested to comply with customer and code specifications. Mesta Forged Fittings and Pipe provide confident service in High Pressure and High Temperature Piping Systems.

MESTA FACILITIES

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Electric Steel and Open Hearth Furnaces
Forging Presses • Heavy Duty Machine Tools
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ROLLING MILLS • ROLLS • FORGINGS • HEAVY DUTY TOOLS

MESTA MACHINE COMPANY

PITTSBURGH, PENNSYLVANIA

Which is the best dust collection system?

Five factors influence the choice of a dust collection system: dust characteristics, gas characteristics, efficiency required, installation and operation costs, and limitations of space or draft loss. In every installation, exclusive Buell features provide *extra efficiency*. A booklet, "The Collection and Recovery of Industrial Dusts", provides valuable, specific details. Just write Dept. 50-E, Buell Enginering Company, Inc. 123 William St., N. Y. 38, N. Y.

A **Buell Cyclones** offer exclusive Shave-off which harnesses double-eddy currents and puts them to work, large diameter design which eliminates bridging and clogging.

B **Buell "SF" Electric Precipitator** delivers extra collection efficiency through use of unique high emission, selftensioning Spiralectrodes and exclusive Continuous Cycle Rapping.

C **Buell Combination Cyclone-Precipitator Systems** combine exclusive Buell features for extra efficiency where extremely high performance standards must be met.

buell®

Experts at delivering Extra Efficiency in

DUST COLLECTION SYSTEMS

Generators

Continued from page 184

consumption indicates the need for a system check.

Increasing hydrogen pressure increases leakage, but not in the ratio of the gage pressure. Going from 0.5 to 15 psig often increases hydrogen consumption by 30 to 50%, which appears to be approximately as the ratio of the square root of absolute pressures. Probably the actual effect depends on the proportion of gas leaked out to atmosphere and that absorbed in the sealing oil.

Hydrogen vents. Hydrogen is much lighter than air. Thus it tends to rise and accumulate in closed areas near the ceiling. Explosive mixtures can form if there are no air currents to diffuse the gas. It is a good precaution to vent ceilings above hydrogen supply centers so any leakage escapes and mixes with the surrounding air.

Lines for purging hydrogen from generators should be run outside the powerhouse to a spot where hydrogen mixes with the air and is quickly carried away.

Also, the discharge line from the oil tank vapor extractor should run to the roof or to an exposed side of the building. Oil used for generator hydrogen seals is usually associated with the main oil tank and system, and some hydrogen is likely to accumulate and be removed by the vapor extractor.

The vapor-extractor discharge line often shows a troublesome drip caused by light oil in the vapor. This condenses on the cold surface of the discharge line. It is very harmful to the usual tar-base roofing and should be kept off the roof and carried some place where it will not make trouble. Some plants have collector traps and return lines to return the entrained or condensed oil to the oil tank.

Using hydrogen safely demands treating it with respect. Always remember that it is flammable and explosive when mixed with the right proportions of oxygen.

Possible delays in obtaining filled hydrogen cylinders make it advisable to keep several weeks' supply on hand. But fire insurance company regulations generally do not permit storing more than three or four full

(*Continued on page* 188)

GENERAL CONTROLS HYDRAMOTOR ®

Hydramotor H-3—This model has cast carbon steel body gate for tight shut-off of gas, oil or liquids. 1000 psi. Motor is explosion-proof, weather-proof. Typical use: high pressure shut-off on oil wells.

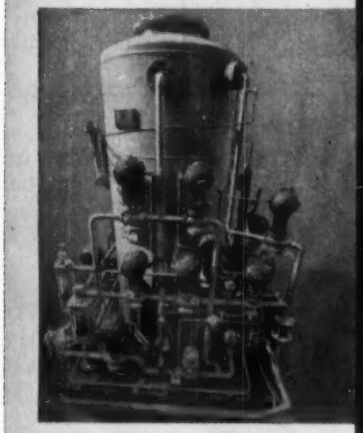
ADVANCED DESIGN HYDRAMOTOR

A MOTOR VALVE YOU CAN USE ANYWHERE!

Here is a motor valve that's truly versatile... the General Controls Hydramotor! A complete line covers positive shut-off control for gases and liquids at all pressures, and they're at home anywhere, inside or out, hot or cold.

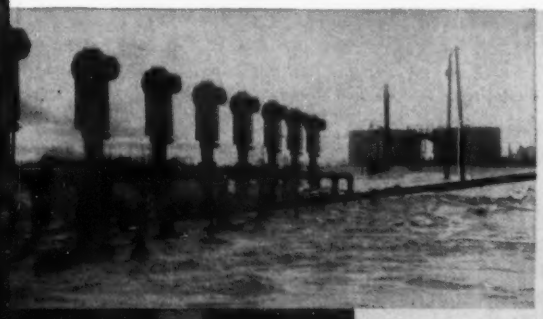
Simple, rugged electro-hydraulic operators operate on two-wire electrical circuits... they fail-safe under powerful steel spring closure in the event of power interruption. Fast and slow opening and closing speeds available.

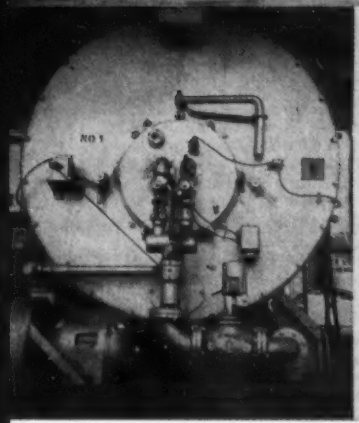
Write today for the complete Hydramotor Catalog, or contact the nearest General Controls branch listed in the yellow pages.



NO BRAWN NEEDED

This ion exchange chamber for boiler feedwater treatment has 17 Hydramotors for flow control. The boiler room crew can busy itself on more important duties than tending valves!





RUGGED, OUTDOOR TYPE

These gathering system valves are always ready. A simple two-wire circuit is all you need to control a Hydramotor. It works easily at any temperature... arctic cold or desert heat, where personnel couldn't ordinarily reach a manual valve.

POSITIVE SHUT-OFF

sold this package boiler manufacturer on applying this Hydramotor on the fuel line to this big gas-fired boiler... he wanted positive shut-off, tight sealing, in current failure or "over temperature" situations. FM & U.L. approved.

Six Plants:
Glendale, California
Burbank, California
Iron Mountain, Michigan
Skokie, Illinois
Guelph, Canada
Providence, Rhode Island

GENERAL CONTROLS

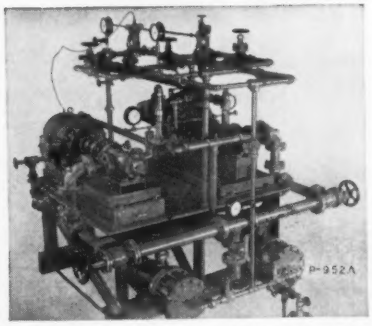
America's Finest Automatic Controls for Home, Industry, and the Military

Factory Branch Offices Serving *All* Principal Cities of the United States and Canada

NATIONAL AIROIL

SERVING INDUSTRY'S COMBUSTION REQUIREMENTS FOR 46 YEARS

NATIONAL AIROIL
FUEL OIL PUMPING and HEATING UNITS



P-952A—Steam Turbine and Electric Motor drive gives flexibility in this compact Model P-ES2H size No. 25 unit.

Complete range of sizes and models in both medium and high pressure types . . . *more compact than ever!* Write for Bulletin 40.

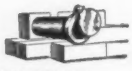
NATIONAL AIROIL
COMBUSTION ACCESSORIES

AIR CONTROL DOOR and FRAME

FUEL-OIL SUCTION STRAINER

WIDE VIEW PEEPHOLE

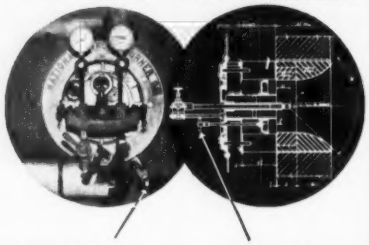
IGNITION PORT



FURNACE RELIEF and ACCESS DOOR

These and other "accessory items" for every industrial liquid fuel-gas installation. Ask for Brochure No. 10.

NATIONAL AIROIL BURNER
NATIONAL AIROIL UNIVERSAL REGISTERS with TYPE "SA" OIL BURNERS



Control for Air Vane

Control for Refractory Faced Disk

BETTER PERFORMANCE with NATIONAL AIROIL Universal Registers because they have a DUAL FEATURE for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disc control. Both adjustments can be made while the burner is firing.

Another "dual advantage" of NATIONAL AIROIL Universal Registers is that they are equipped for dual fuel firing of gas and oil. Universal Registers with burners are available in three (3) sizes . . . capacities up to 60,000 lbs. of steam produced per burner per hour. Write for Bulletin 51.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNERS
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, Combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.

Main Office and Factory: 1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.

Southwestern Division: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

Generators

Continued from page 86

cylinders in addition to those set in the pressure supply station.

This means that excess cylinders must be stored in a separate building where, if a higher insurance rate is applicable, it will not apply to a highly valued structure.

Don't store full cylinders in the hot sun. Pressures may increase to the danger point. Also, take care in handling cylinders. A tank filled with gas at several thousand psi is dangerous if it ruptures.

Comment

Continued from page 134

cause of large pipe diameter and medium steam conditions, was perhaps not completely convincing to people concerned with 1- to 6-in. piping handling low-pressure process steam. I'd like to emphasize that savings indicated by your article are proportionately true in calculating correct insulation thickness for smaller pipe sizes.

P H KING, *Glen Waverly, Victoria, Australia*

More tips on pump testing

Your article on pump testing (POWER, Dec 1957, p 136) was particularly interesting because we'd just completed a series of tests of pumps handling crude oil. Here are some of our conclusions:

Power factor measurement by conventional power-factor meters isn't normally considered too accurate and should definitely be checked by (1) ratio between kva and kw or (2) motor manufacturer's data.

On large units where motor-control equipment includes both current and potential transformers, phase relationship must have careful attention if a watt meter is used, because it's possible to get several readings near enough to the actual to appear logical.

Speed determination can also present problems. Tachometer or revolution-counter use requires a center hole which may not be easily or safely available in larger units. Unless the instrument is used properly, large and unknown errors can result.

A stroboscopic-light unit and stop watch to measure slip has some ad-

Complete control
of temperatures with
PABCO
PRECISION-MOLDED
CALTEMP
a Calcium Silicate
Insulation

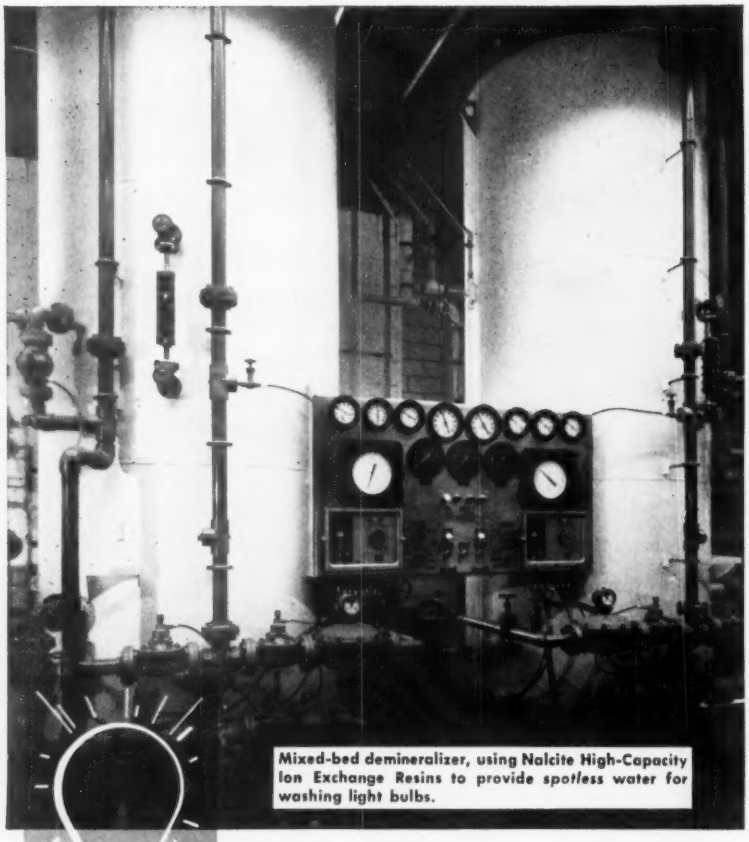
Name your temperature. A performance-proved Pabco pipe or block insulation will maintain it at economical levels up to 1900° F. With Pabco Caltemp, 85% Magnesia, or Prasco Insulations, heat losses are reduced to an absolute minimum . . . finest performance assured. For data on technical advantages, case histories, or engineering consultation . . . write . . . or contact one of Pabco's insulation engineers.

PABCO INDUSTRIAL INSULATIONS DIVISION

Fibreboard Paper Products Corporation • San Francisco 19 • Chicago 54 • Houston 4 • New York 16 • Los Angeles

INSULATION GUIDE

Temperature	Recommended Pabco Insulation
to 550° F.	85% Magnesia pipe covering • block • cement
to 1200° F.	Caltemp pipe covering • block • cement
to 1300° F.	Prasco 15 C pipe covering • block • cement
to 1900° F.	Prasco 19 C block


Mixed-bed demineralizer, using Nalcite High-Capacity Ion Exchange Resins to provide spotless water for washing light bulbs.

BRIGHT IDEA!
for spotless light bulbs

Nalcite® DEMINERALIZED WATER

Highest quality demineralized water is needed to wash light bulbs to sparkling spotlessness for this major manufacturer . . . Nalcite Cation and Anion Exchange Resins, working in a modern mixed-bed demineralizer, do the job here — as they can do it on any water that needs upgrading for most efficient use.

Whether you want to wash a light bulb or get better boiler feed water, Nalcite Exchangers have capacity, stability and other performance advantages you should know about.

NEW WATER CONDITIONING HANDBOOK
Sixty pages of concentrated data and useful tables on water conditioning with Nalcite Ion Exchangers. Your copy free on request. Ask for Bulletin Z-5.

NATIONAL ALUMINATE CORPORATION
6222 West 66th Place Chicago 38, Illinois
Canada: Alchem Limited, Burlington, Ontario

Nalco® PRODUCTS

Serving Industry through Practical Applied Science

Comment

Continued from page 188

vantages as a speed-determination method. Slip is subtracted from synchronous speed to determine operating speed.

If accurate pump tests are to be made on electrically driven units, manufacturer's "Certified test curves and data" should be obtained for the motors. Curves are usually made at rated voltage and corrections must be made if voltage varies appreciably. Usually no voltage control is possible, but if maximum accuracy is wanted the voltage can be controlled during testing by prior arrangement with the power company.

Hydraulically, our tests were made in actual service with carefully controlled flow rate checked between oil into the line and oil delivered, with the line steadied to eliminate cycling. Testing on other than water obviously required careful sampling and lab analysis of material being pumped.

C D BATCHELDER, *Chief Engineer Portland Pipe Line Co, Portland, Me.*

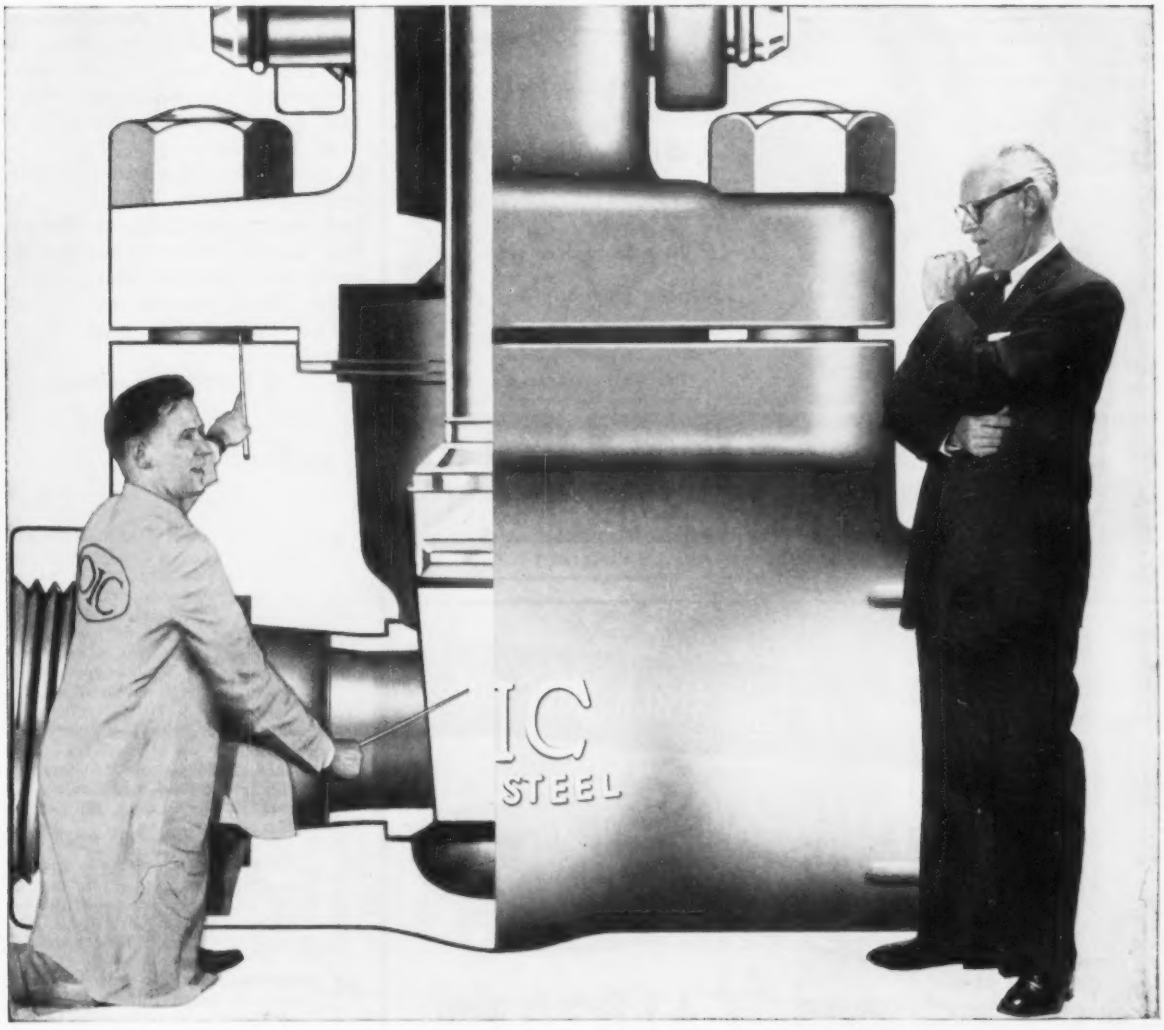
My biggest boner

It was early morning, May 17, 1930. The new cruiser *USS Northampton* lay alongside the dock, her auxiliaries in operation, gradually coming to life while awaiting her commissioning scheduled for later in the day.

As the electrician-on-watch, I noticed a steadily rising load on the ship's service power. So I warmed up another generator, before cutting it in. I brought up the voltage (or so I believed) on the incoming generator to a setting just slightly above that of the operating generator. Then I threw the big knife switches to put it on the line.

WHAM ! ! ! Total darkness and the excited scramble of feet. The inevitable "brass" descended into the engine room swinging flashilght beams. All asked questions at the same time. Thank goodness no one had tampered with the trip elements and safety devices, for I had brought up the voltage on the operating gen-

...and you can see here....and here, sir, how we've killed maintenance problems on our new forged steel lines.



We stop galling and erosion by giving you 13% chrome stainless steel trim with wedges *duracased* to a rugged *1000 Brinell hardness.*

The square and *bolted* body-bonnet joint makes it easy to service the valve quicker. And it's a tighter joint, made doubly leakproof by recessing the soft iron gasket into the body. The gasket can't blow!

And you get the fastest joint make-up you've ever seen. Look at those pipe ends. See the extra wrench-gripping area and lugs. See how body-bonnet flanges are out of the wrench's way. No time lost here!

These new 600-lb. OIC forged steel valves are available with either *high-flow* ports (1300 line), or *standard-flow* ports (1100 line). Call your OIC Distributor, or write for specification literature.

The Ohio Injector Company • Wadsworth, Ohio

OIC VALVES | BRONZE, IRON, FORGED AND CAST STEEL, LUBRICATED PLUG VALVES

Replacement Tubes

BOILER TUBE
COMPANY OF AMERICA
McKEES ROCKS, PA. (Pittsburgh District) Federal 1-7750

When this stack goes up

your costs go down

A. O. Smith *Permaglas*® smokestacks—glass-protected inside and out . . . are virtually impervious to condensate corrosion

Write for free bulletin SS-202 illustrating how to get greater return from your stack investment

A. O. Smith Corporation, Dept. P-5, Milwaukee 1, Wis.
Please send me a copy of the Permaglas Smokestack Bulletin No. SS-202.
Name_____ Title_____
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Through research ... *a better way*
A.O.Smith CORPORATION
PERMAGLAS SMOKESTACK SALES
PROCESS EQUIPMENT DIVISION
MILWAUKEE 1, WISCONSIN

Boner

Continued from page 190

erator. Switchboard had a selective voltmeter, and I had mistakenly selected the wrong generator. That actuated the reverse current trip on the incoming machine and the overload device on the one operating.

I had visions of the crow flying off with my rating badge. But the chief engineer and electrical officer decided that, since no damage was done, it could be charged up to experience. However, they did recommend individual voltmeters. With it all, my embarrassment probably avoided future casualties at sea, for the separate meters were installed shortly afterward. During the six years I was aboard that ship there wasn't a single recurrence.

W E Brumby, *Levittown, Pa.*

Free literature

Begins on page 157

11 **Controls** for electric equipment general-purpose type, are subject of 88-p catalog GEC-1260C. Selection charts cover starters through 200 hp; product descriptions are included of contactors, relays, solenoids, limit switches. General Electric Co, General Purpose Control Dept, Bloomington, Ill.

12 **Synchronous induction motor** is subject of 8-p bulletin 1900. Graphs, illustrations demonstrate design principles. The Louis Allis Co, 427 E Stewart St, Milwaukee 1, Wis.

13 **Cable-supporting systems,** including cable trough, cable ladder, cable channel are discussed in 60-p looseleaf catalog. T J Cope Div, Rome Cable Corp, Collegeville, Pa.

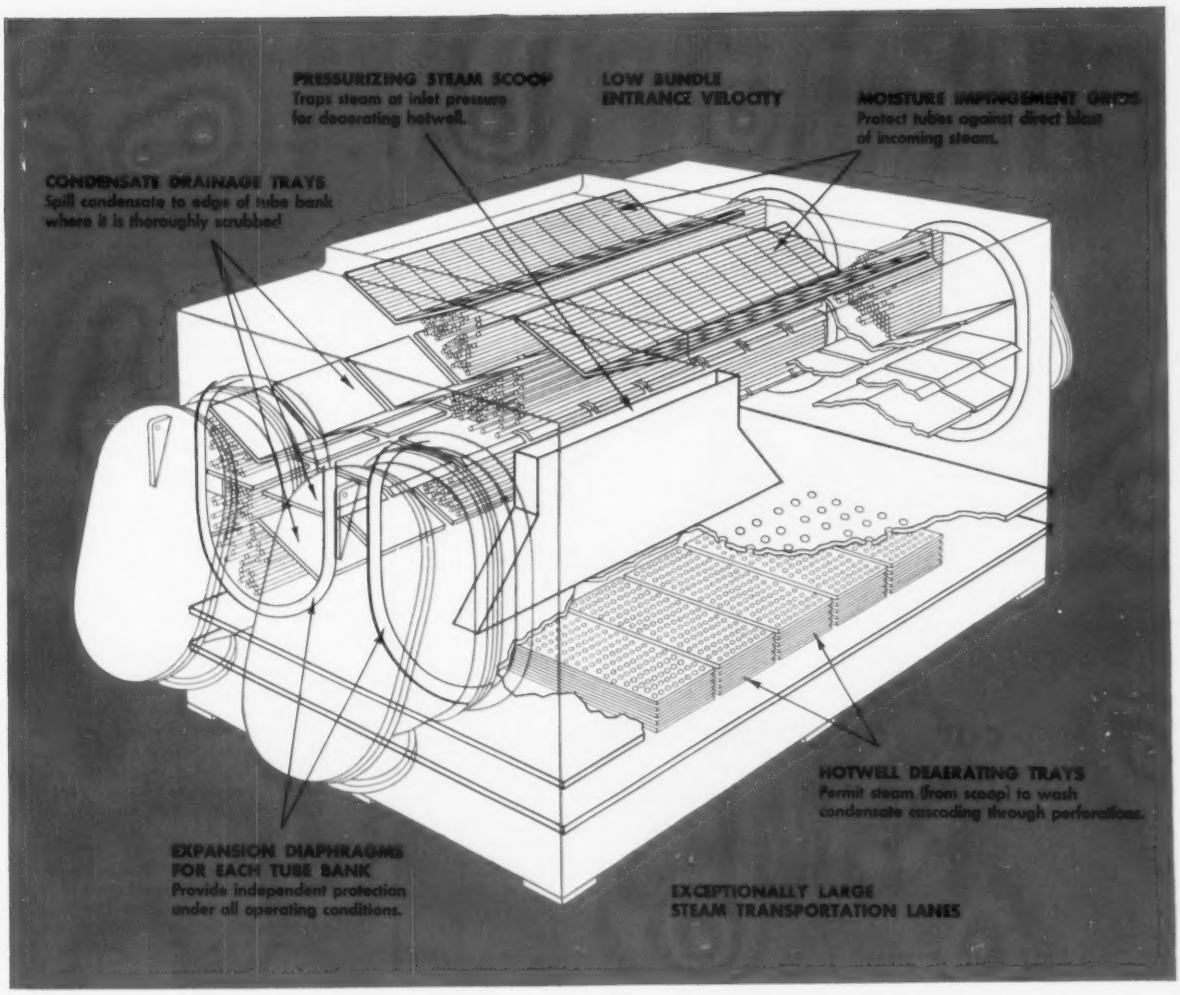
14 **Industrial batteries** are described in service manual. Info given includes photos, charts, tables, maintenance data. C & D Batteries, Inc, Conshohocken, Pa.

15 **RM medium transformers,** 501-5000 kva, are described in 32-p bulletin GEA-6108B. Electrical characteristics and mechanical features are discussed. Data given include ratings, performance data, dimensions. General Electric Co, Schenectady 5, N. Y.

SAFETY EQUIPMENT

16 **Air-fed oven suits** are subject of bulletin 1301-1. Aluminized asbestos suits reflect 90% of radiant energy to speed furnace repair. Mine Safety Appliances Co, 201 N Braddock Ave, Pittsburgh 8, Pa.

(*Continued on page 194*)


PRESSURIZING STEAM SCOOP
Traps steam at inlet pressure for deaerating hotwell.
LOW BUNDLE ENTRANCE VELOCITY
MOISTURE IMPINGEMENT GRIDS
Protect tubes against direct blast of incoming steam.
CONDENSATE DRAINAGE TRAYS
Spill condensate to edge of tube bank where it is thoroughly scrubbed
HOTWELL DEAERATING TRAYS
Permit steam (from scoop) to wash condensate cascading through perforations.
EXPANSION DIAPHRAGMS FOR EACH TUBE BANK
Provide independent protection under all operating conditions.
EXCEPTIONALLY LARGE STEAM TRANSPORTATION LANES

Take an inside look at the exclusive "extras" in

ROSS SURFACE CONDENSERS

Nowhere in the industry . . . *nowhere in the world* . . . can you match the extra, exclusive values built into Ross Surface Condensers. The "inside story" is unfolded for you in the 110,000 sq. ft. unit shown here. Study it. Compare it. Draw your own conclusions.

American-Standard*, Ross Heat Exchanger Division has over 40 years' experience in the Surface Condenser field, backgrounded by a string of design "firsts" too long to list here. With a large new plant devoted exclusively to condensers and special heat transfer equipment, Ross is singularly qualified to build the equipment you need . . . any size, any number, for any set of conditions.

What are your requirements? Your inquiry will bring a nearby Ross engineer to your desk, or if you prefer, Condenser Bulletin 8.2K1 will be mailed with no strings attached.

American-Standard, Ross Heat Exchanger Division, Buffalo 5, N. Y. In Canada: American-Standard Products (Canada) Limited, Station D, Toronto, Ont.

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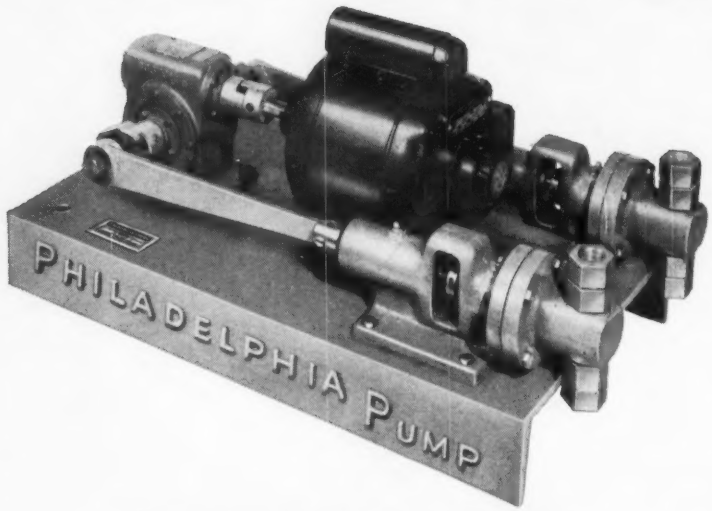
AMERICAN-Standard
ROSS HEAT EXCHANGER DIVISION

PHILADELPHIA



controlled capacity

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Accuracy and low maintenance to meet fluid proportioning requirements in Chemical Processing, Refining and Boiler Feed Applications.

Philadelphia proportioning pumps feed precisely metered fluids or slurries into low or high pressure systems in nearly any desired ratio with flow, temperature, pressure, conductivity, PH and other controlled process variables. Control may be manual or automatic—with electric, hydraulic or pneumatic systems.

Models may be obtained to handle a great variety of "tough," corrosive and viscous materials. *Write for full information.*

AMERICAN
METER COMPANY
PUMP DIVISION
13500 Philmont Avenue, Philadelphia 16, Pennsylvania

High-Pressure Pumps • Controlled Capacity Pumps • Chemical Feed Systems

Free literature

Begins on page 157

★ **Explosion-hazard check list** is given in 8-p folder. Questions help decide whether plant is safe from electrically ignited explosions. ★Request direct on company letterhead. Crouse Hinds Co. Dept HF, Wolf & 7th N Sts, Syracuse, N. Y.

17 **Fire-extinguishing systems,** fire-detection equipment and burglar alarms are discussed in 8-p brochure I-19. Walter Kidde & Co, Inc, 675 Main St, Belleville 9, N. J.

MAINTENANCE MATERIALS

18 **Fire-resistant material** is subject of 4-p bulletin. Includes rating tables, spec guide. Columbia Acoustics & Fireproofing Co, Stanhope, N. J.

19 **High-temperature** insulating block and cement is described in 8-p booklet. Gives thermal characteristics, photos, specs. Baldwin-Hill Co, Engineering Dept, 500 Breunig Ave, Trenton 2, N. J.

20 **Nondestructive-testing** service is described in 10-p brochure. Treats various types of inspection available. Magnaflux Corp, 7300 W Lawrence Ave, Chicago 31, Ill.

21 **Protective coatings** are subject of 36-p manual 257. Features color chips of 102 coating items; sections on surface preparation, use of primers, finish coatings. Rust-Oleum Corp, 2799 Oakton St, Evanston, Ill.

22 **Silicones are treated** in 16-p catalog. Describes various uses: as dielectrics, heat-transfer fluid, lubes, transducer fluid. Dow Corning Corp, Midland, Mich.

23 **Anticorrosion coating** for mild steel is subject of 4-p bulletin. Discusses method, application, advantages, costs. Tube Reducing Corp, Box 959, Passaic, N. J.

CONTROLS, METERS & INSTRUMENTS

24 **Chemical-feeder automation** is treated in 8-p bulletin B-I-F-P7. Contains schematic diagrams of typical arrangements. Omega Machine Co, 345 Harris Ave, Providence 1, R. I.

25 **Signaling controller** for electrolytic conductivity is described in 2-p data sheet ND47-95. Describes uses in detecting condensate purity, ratio measurements for ion exchangers, acid control. Leeds & Northrup Co, 4934 Stenton Ave, Philadelphia 44, Pa.

26 **Metering** and control systems are described in 4-p bulletin 500. Includes pneumatic and electric telemetering, pneumatic control. Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio.

(*Continued on page* 196)

O-B VALVES

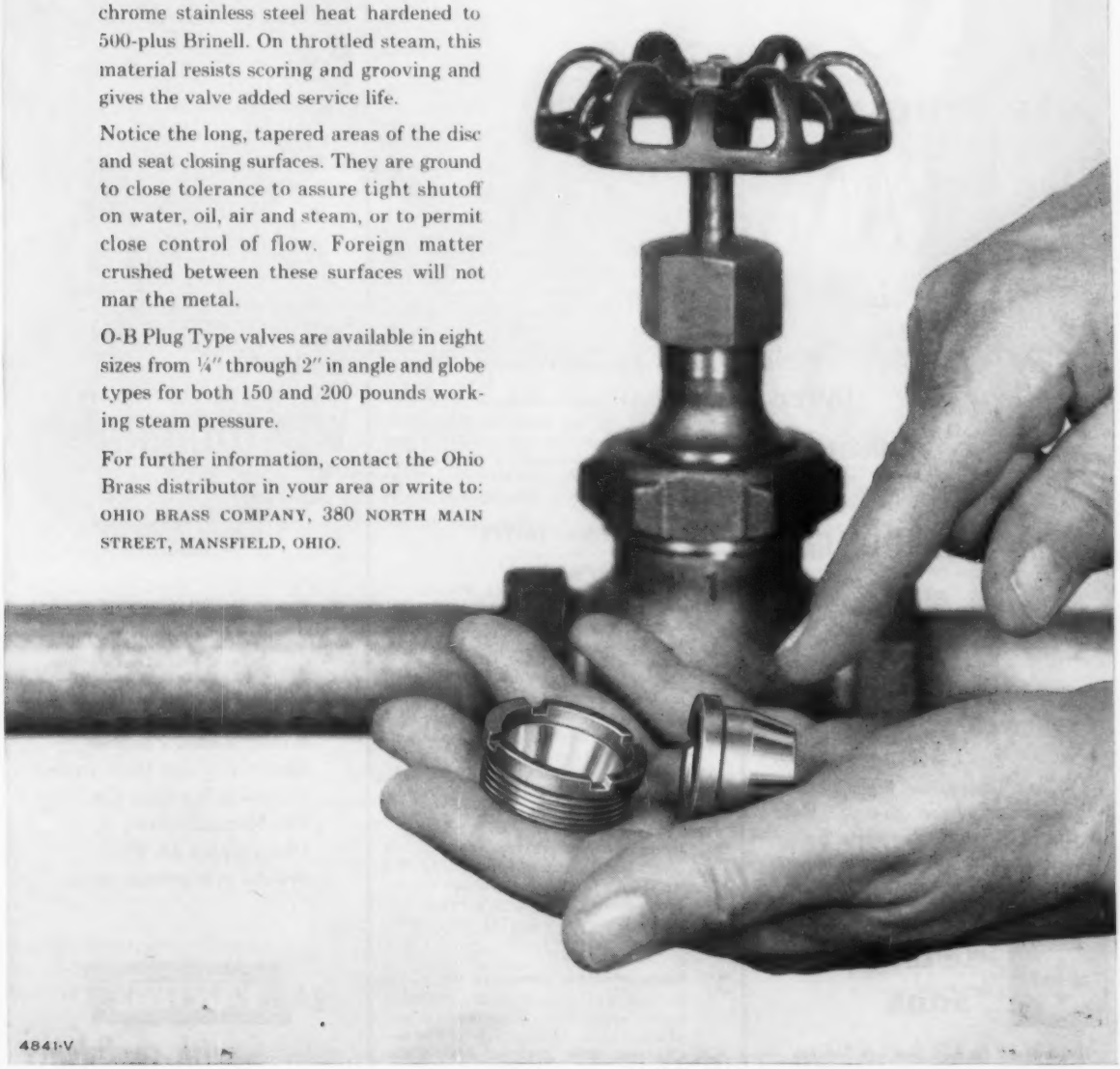
when throttling steam . . . use stainless steel seat and disc

The O-B Plug Type valve is made for tough throttling jobs . . . especially the throttling of steam. Seat and disc are chrome stainless steel heat hardened to 500-plus Brinell. On throttled steam, this material resists scoring and grooving and gives the valve added service life.

Notice the long, tapered areas of the disc and seat closing surfaces. They are ground to close tolerance to assure tight shutoff on water, oil, air and steam, or to permit close control of flow. Foreign matter crushed between these surfaces will not mar the metal.

O-B Plug Type valves are available in eight sizes from ¼" through 2" in angle and globe types for both 150 and 200 pounds working steam pressure.

For further information, contact the Ohio Brass distributor in your area or write to: OHIO BRASS COMPANY, 380 NORTH MAIN STREET, MANSFIELD, OHIO.



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FANtastic

Aeromaster FANS

increase cooling tower efficiency with MORE CFM and LESS HP

Precision engineered Aeromaster Fans with variable pitch blades and anti-flutter design give cooling at *lower cost.* Blades resist acids, alkalies, abrasion and weather. 4, 6 or 8 blade styles in 54″ to 22′ diameters. Before you replace or consider new equipment, write: KOPPERS COMPANY, INC., 2605 Scott Street, Baltimore 3, Md.

KOPPERS Aeromaster Fans

Engineered Products Sold with *Service*

Free literature

Begins on page 157

27 **Automatic controls** are subject of 60-p catalog 858. Gives data on pressure, temperature, liquid level and mechanical-movement controls; relays and switches. The Mercoid Corp, 4201 Belmont Ave, Chicago 41, Ill.

28 **Computers** are described in 6-p folder. Includes full description of programming. Bendix Computer Div, 5630 Arbor Vitae St, Los Angeles 45, Calif.

NUCLEAR ENERGY

29 **Radioactivity detection** is subject of 2-p data sheet PC-58. Compares seven main counting systems on 13 points. Nuclear Measurements Corp, 2460 N Arlington Ave, Indianapolis 18, Ind.

30 **Ion chambers** are discussed in 4-p bulletin GEA-6631. Gives technical data, specs. General Electric Co, Schenectady 5, N. Y.

31 **Gamma-ray** technical report is a 15-p booklet. Describes their generation for experimental measurement of radiation effect, for commercial radiation processing. Applied Radiation Corp, Walnut Creek, Calif.

32 **Nuclear safety** is title of 12-p booklet describing services of company. Technical reports are also available, on reactor-hazards analysis, vessel design for explosive mixtures, fragment effects on structural elements. Holmes & Narver, Inc, 828 S Figueroa St, Los Angeles 17, Calif.

33 **Nuclear fuel elements** are discussed in 4-p bulletin GEA-6762. Describes company's facilities for design, development, testing of plate and rod-type elements. General Electric Co, Schenectady, N. Y.

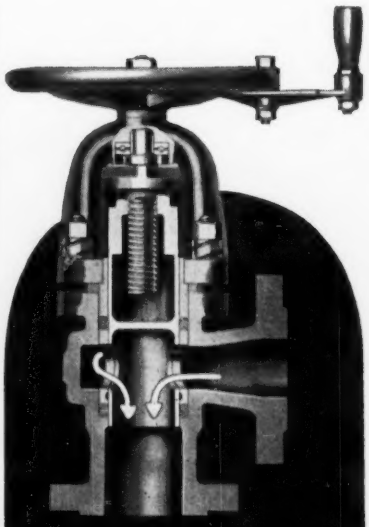
PIPING, VALVES

34 **Swing check valves** for steam and water-line service are subject of 4-p bulletin 8K. Sectional drawings included. Schutte and Koerting Co, Dept V-D, Cornwells Hgts, Bucks County, Pa.

35 **Super-alloy tubing** is discussed in 10-p bulletin 70. Gives chemical composition, physical and mechanical properties of 16 alloys for 25,000 psi application at 1200 F. Superior Tube Co, 1778 Germantown Ave, Norristown, Pa.

36 **Bronze globe valves,** angle and check units are discussed in 4-p bulletin. Includes exploded views, dimensional drawings, service ratings. Walworth Co, 750 Third Ave, New York 17, N. Y.

37 **Impulse steam traps** are discussed in 8-p bulletin T-1742. Includes installation info, dimensional, capacity data. Yarnall-Waring Co, Chestnut Hill, Philadelphia 18, Pa.



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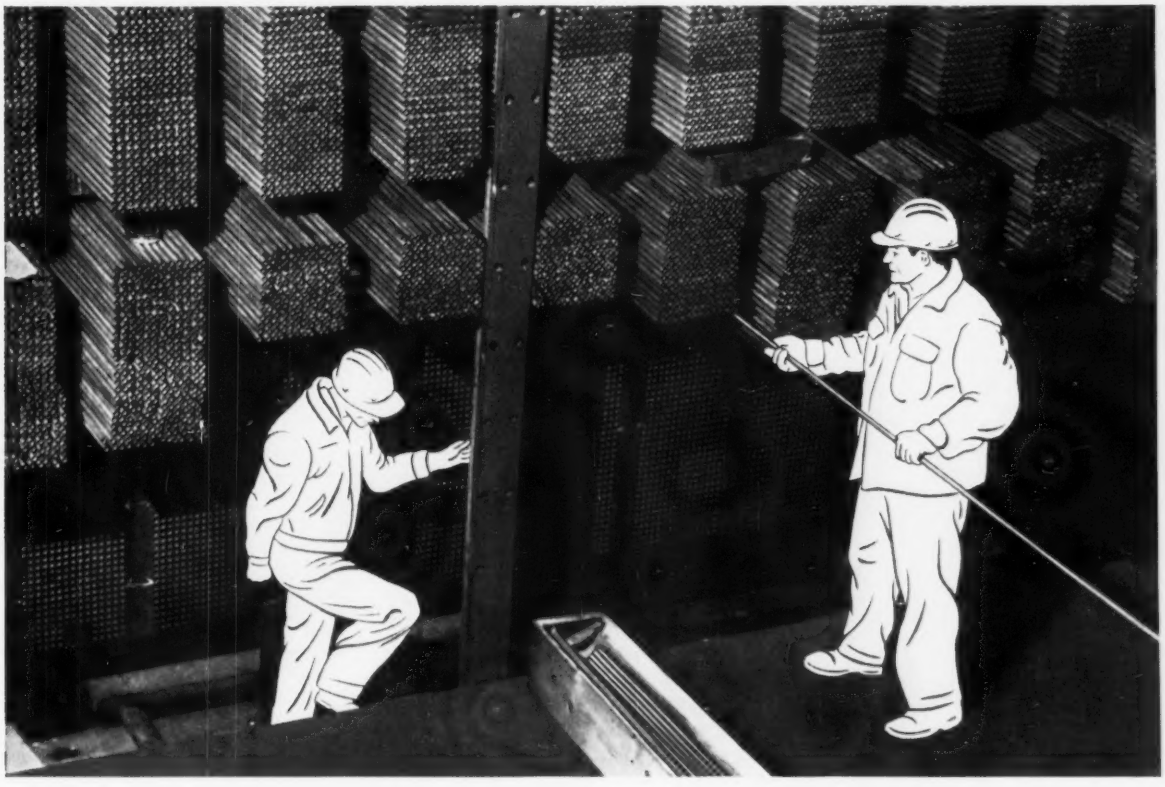

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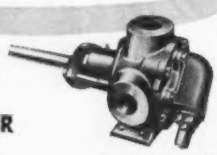

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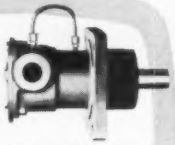

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Demineralizing

Continued from page 96

the very low levels mentioned earlier. Makeup is polished by introducing it into the feedwater stream ahead of the scavenger units.

This arrangement is used for the supercritical plant of Cleveland Electric Illuminating Company, Avon, Ohio. But rate of flow through their three mixed-bed scavengers is under 15 gpm per sq ft when handling 100% feedwater (2400 gpm) in an emergency with only two units on the line. Rate of 15 gpm per sq ft is also used on the five large mixed-bed demineralizers handling 4000 gpm of treated makeup at the Linden Generating Station of Public Service Electric and Gas Co of New Jersey.

We are presently conducting long-term research with a pilot plant on flow rates higher than 15 gpm per sq ft on scavenger mixed beds. What is the effect of high pressure losses caused by these high flow rates? Will the ion-exchange beads crush? How can channeling be avoided? All these factors are being studied in the pilot-plant tests.

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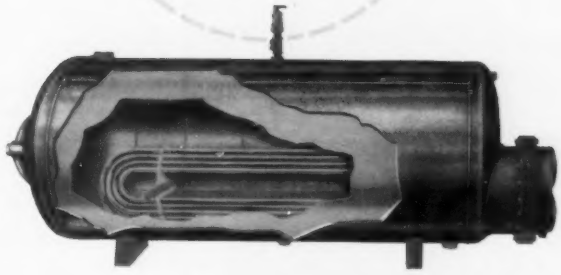

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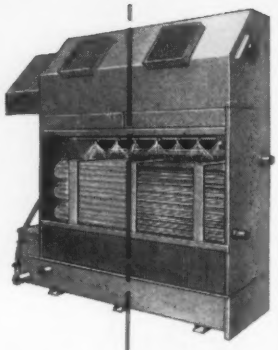

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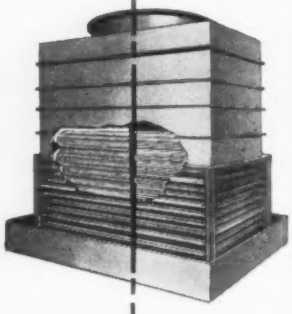

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Technical briefs

Begins on page 146

problems; statistical; probability; forecasting; turbines, boilers, water rates, heat balances, fuels; hydro stations. *AIEE paper, No. CP 58-243*

Meters and instruments

Problems in measuring steam flow at 1250 psia and 950 F with nozzles and orifices. *By J W Murdock, Naval Boiler and Turbine Laboratory, and J Goldsbury, General Electric Co*

Measurement of steam flow at 1250 psia and 950 F with nozzles and orifices is discussed (1) during their calibration and (2) during performance tests on a turbine.

Calibrations for the flow nozzles indicated that reliable, repeatable results could be obtained although one nozzle exhibited an abrupt increase in discharge coefficient of about 0.5% at about 2% pressure differential. The measured coefficients of discharge were within *Power Test Code* "probable tolerances" of ± 1.25%. Calibrations of the orifices were of little value because of permanent distortion of orifice plates as a result of difference in expansion between plates and their holding flanges.

For measuring steam flows to the turbine, additional orifices were made up of different material, reducing plate distortion to the point of being negligible. Results of the turbine test with orifices and nozzles in series indicated excellent agreement between the flows based on orifice data using calculated coefficients and those determined from nozzle data using coefficients obtained from the calibration. Some trouble was experienced from deposits found around the nozzle throat taps. *ASME paper, No. 57-A-88*

Liquid flowmeter calibration techniques. *By M R Shafer and F W Ruegg, National Bureau of Standards*

Calibration techniques for liquid flowmeters are discussed with emphasis on problems known to influence the accuracy of calibration procedures. Also, reference methods that have been used to evaluate the

Directions for ordering papers on page 204

Chicken wire helps mechanic cut insulation costs

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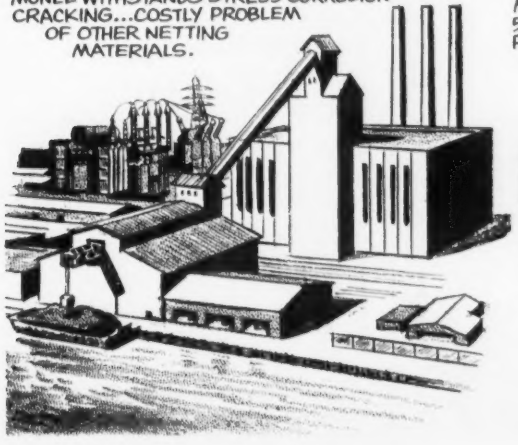

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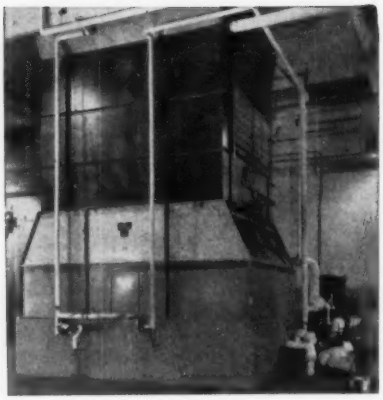

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Technical briefs

Begins on page 146

comparative accuracy of different calibrators are described.

The results of comparative accuracy tests on four calibrators of different designs are presented and it is shown that the agreement between these is within ± 0.15% in the test range of 10,000 to 100,000 lb per hr. The many precautions necessary to approach this precision from the traditionally accepted ± 1% are given in detail. *ASME paper, No. 57-A-70*

Steady-state axial-flow forces on pneumatic spool-type control valves. *By T-Y Feng, Minneapolis-Honeywell Regulator Co*

The momentum theory is used to determine steady-state axial-flow forces on a pneumatic control-valve spool, caused by compressible fluid passing through the sharp-edged orifice. The experimental results compare favorably with theoretical calculations for valve displacements of 0.005 in. and less at supply pressures not exceeding 500 psig.

Pneumatic flow forces as compared with hydraulic flow forces on the same valve spool are higher in the unchoked-flow regime, but lower in the choked-flow regime. *ASME paper, No. 57-A-129*

Dimensionless correlation of coefficients of turbine-type flowmeters. *By H M Hochreiter, Fischer & Porter Co*

Principles of dimensional reasoning are applied to a turbine- or propeller-type kinematic flowmeter. Experimental results are correlated over a wide range of fluid conditions and geometric variations, coefficients are compared against those predicted from a one-dimensional design equation. *ASME paper, No. 57-A-63*

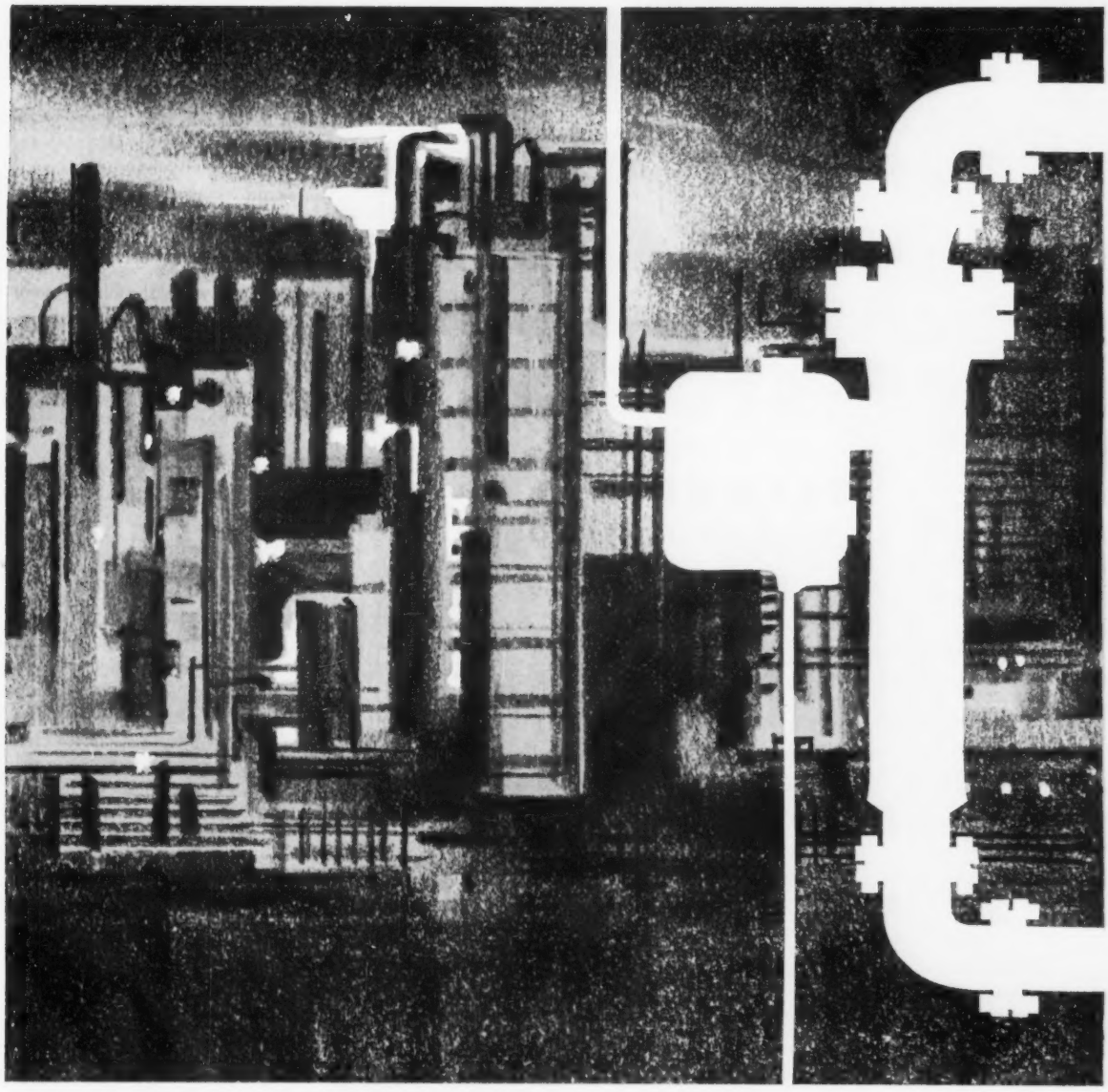
Hydro

Antifriction bearings for kaplan hubs. *By R M Donaldson, Newport News Shipbuilding and Dry Dock Co*

Paper discusses the bearings that support the individual runner blades in the hub of a kaplan turbine. There are three of these bearings for each blade, two radial and one thrust.

Rolling-contact bearings are at-

Directions for ordering papers on page 204



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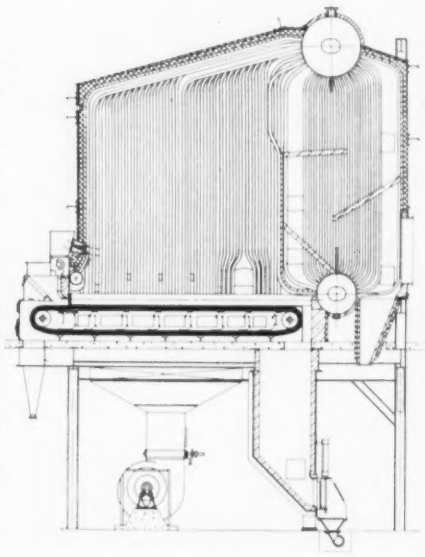

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Technical briefs

Begins on page 146

tractive for kaplan applications. The problem of wear is eliminated; bearing friction becomes negligible, resulting in smaller governor, servomotor and operating gear; hub needn't be kept full of oil. Principal deterrent is fear of damage resulting from vibratory forces, and fear that during periods when the blades were stationary the rollers of the rolling-contact bearings would indent or brinell the races. These problems were solved by full scale experiments and results were more than satisfactory.

It is very probable that rolling-contact bearing construction will become much more general in future installations of kaplan turbines. *AIEE paper, No. 57-686*

Dynamic balancing of hydroelectric units in the field. *By H N Hill, R S Barker and J B Murtland, Aluminum Co of America*

The authors describe a method for dynamic balancing of hydroelectric units using electric strain gage equipment. Using the method to balance a number of 2- and 3-bearing machines has demonstrated that suitable unbalance data can be obtained with SR-4 strain gages and required balance corrections can be calculated from such data.

Method is convenient and provides better results in less time than the cut-and-try process of balancing. Many days of maintenance outage have been saved and maintenance costs have been reduced substantially. *AIEE paper, No. CP 57-219*

TO OBTAIN COMPLETE TEXT

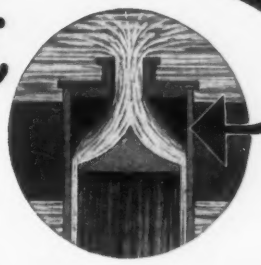
Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

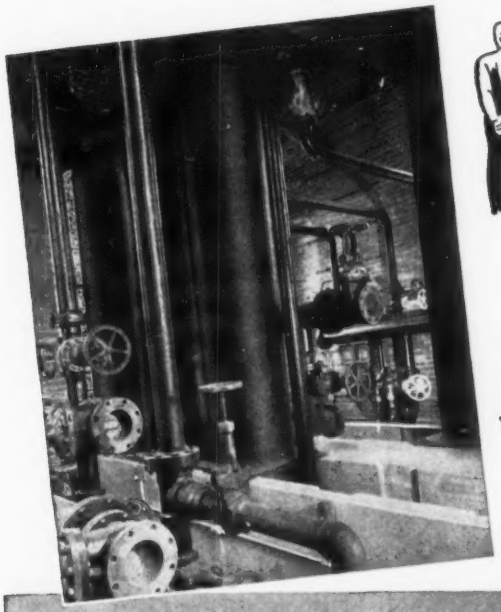
American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 12, New York.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

Dirty Water can't "Shut-down"...

Vogt

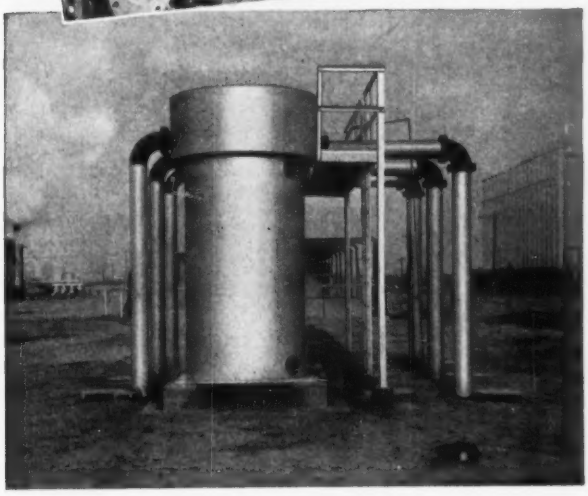




film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

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TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request. Dept 24A-XP.]

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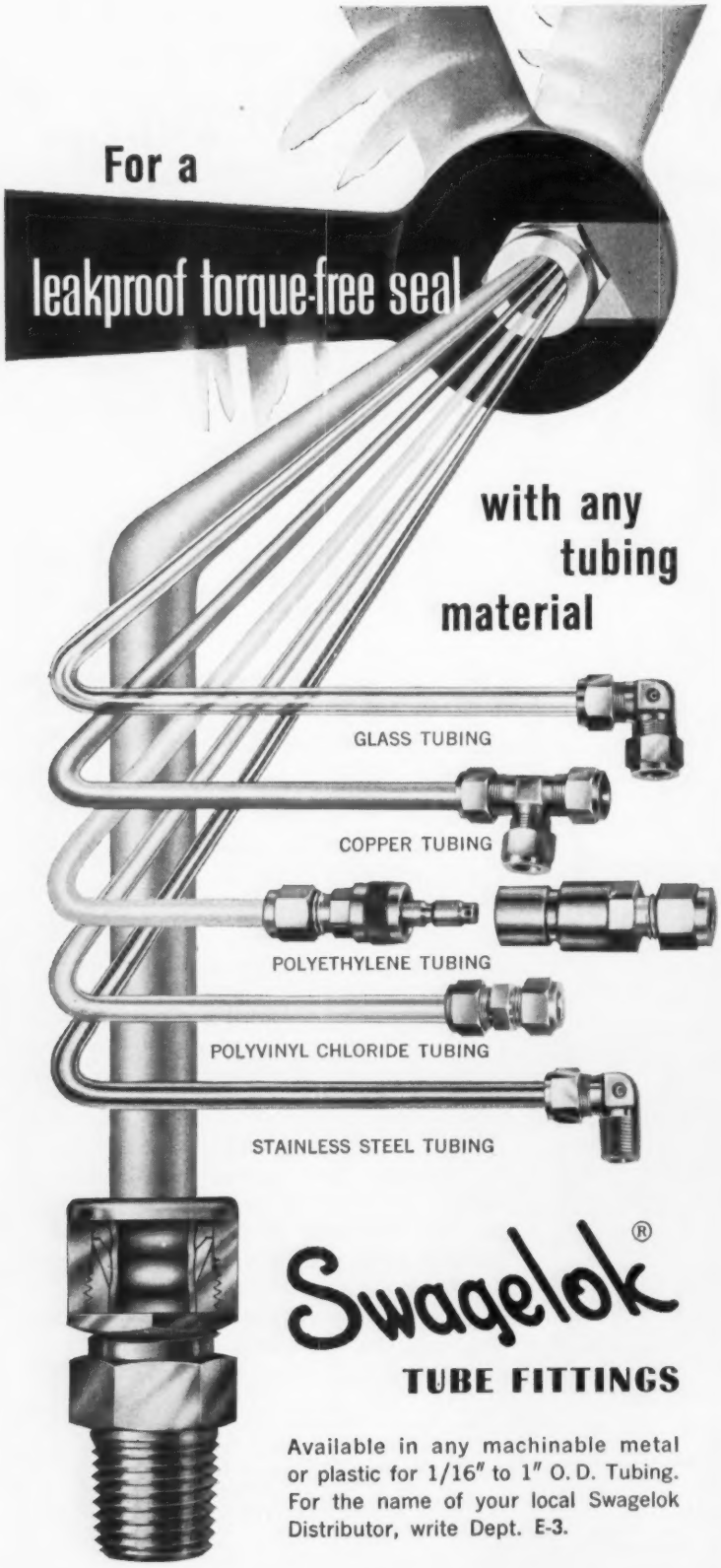

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TUBE FITTINGS

Available in any machinable metal or plastic for 1/16″ to 1″ O. D. Tubing. For the name of your local Swagelok Distributor, write Dept. E-3.

CRAWFORD FITTING COMPANY
884 East 140th Street • Cleveland 10, Ohio

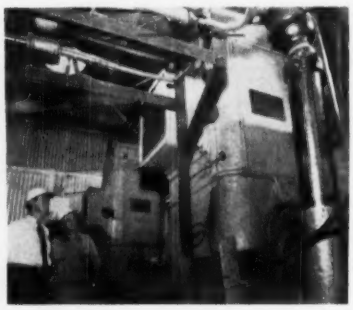
Reports from the field

Begins on page 144

duces electrical energy directly from the chemical energy of hydrogen and oxygen gases. (POWER, January 1958, p 87.) Fuel cell, now almost a year old, has grown more compact. Hydrogen and oxygen electrodes, made of specially-treated porous carbon, are now concentric cylinders nestling within each other and taking oxygen directly from the air.

Model-making par excellence is on display in the M W Kellog Co exhibit. Competing with traditional European models, the U.S. development offers prefabricated plastic components. The preformed plastic parts are scaled 3/8 in. to 1 ft, and designed for quick, accurate snap-together setup. Plant planning and layout design can be accomplished directly with models, cutting down or even eliminating the blueprint stage.

Symbolized by the "Atomium," a building representing the construction of the atom, the first nuclear-age World's Fair opened April 17. U.S. contributions are showcased in a $5,000,000 translucent drum-shaped building reflected in a 230-ft pool, and should be viewed by 35 million visitors.



Antique transformers finally put out to graze

Two of the oldest-timers among electric-power transformers were recently retired after 56 years of continuous service. Units were operating in a Brooklyn shipyard, supplying 25-cycle power for a floating dry dock, and had to be replaced when 60-cycle power was put in.

No one remembered when the transformers had been installed, but a serial-number check revealed that they were begun at General Electric Co's Pittsfield plant on January 7,

This is an illusion

HOLD this Diagram by the right hand bottom corner and give it a slight but *rapid* circular twisting motion, at which time *each circle will separately revolve on its own axis*. The inner cogged wheel will be seen to revolve in an opposite direction.

THIS *is the real thing!*

insul-fil® the most highly efficient and economical "poured-type-insulation" available for underground steam and hot water distribution systems

The following comparative "K" factors were recorded at the Research and Development laboratories of the Atlantic Refining Company, and are evidence of INSUL-FIL's superiority.

The average "K" factor at 150 p.s.i.g. indicated the following values. These values were computed using 6" of material for the comparative evaluation. The average "K" factor on INSUL-FIL and 100% mined asphalt vary slightly depending on thickness of application

"K" VALUES:

PERLITE	.39
INSUL-FIL	.451
100% MINED ASPHALT	.74
SOIL	3.12

Installing contractor Rhode Island Covering Co., U. S. Naval Air Station, Quonset Point, R. I., Charles A. Maguire and Associates, Consulting Engineers, Boston, Mass., Providence, R. I.

Installing INSUL-FIL at Idlewild International Airport for Port of New York Authority. (Seelye, Stevenson, Value & Knecht — Consulting Engineers)

COLLEGES and INDUSTRY use *insul-fil*. Can you afford not to?

INSUL-FIL CO., INC. A DIVISION OF
MIRACLE ADHESIVES CORPORATION 250 Pettit Avenue, Bellmore, L. I., N. Y.

Send now for your **FREE** copy of MIRA-DATA SHEET #9, 4 page colorful brochure describing INSUL-FIL.

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Other Miracle Products for the Insulation Industry:

Zip-on Protektinsul Vinyl Pipe Covering
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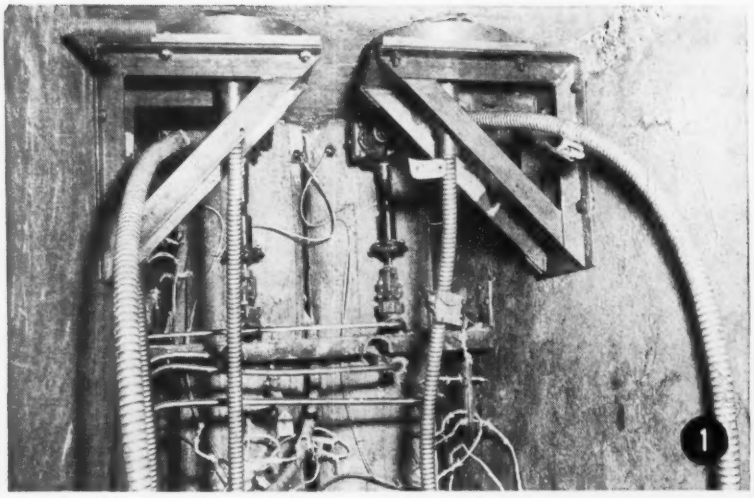
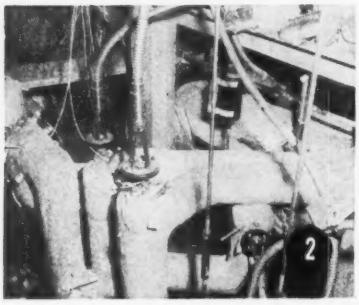
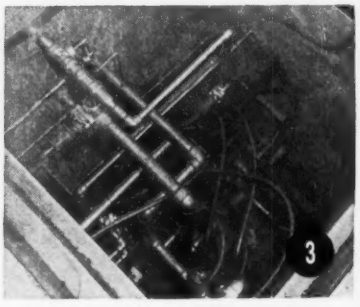






STOW FLEXIBLE SHAFTS USED IN SODIUM REACTOR EXPERIMENT

Photo 1) Two half-inch globe valves located in the center of this photo are controlled by STOW size 40 geared joints connected by STOW flexible shafts. The flexible shafts go through the 6-foot concrete walls and are connected to valve remote operating terminals on the other side. Flexible shafts are used to operate these valves since they can be put in an "S"-shaped path when going through the concrete walls. This prevents radiation escaping from the chamber. These half-inch globe valves are used in the organic cooling system of the Sodium Reactor Experiment, an experimental nuclear power reactor built and operated for the Atomic Energy Commission by Atomics International, a division of North American Aviation, Inc.

Photo 2) STOW remote control flexible shafts control one-inch bellows seal valves, using STOW V2 valve couplings (center of photo). These are installed in the sodium service lines in the main gallery of the Sodium Reactor Experiment. The sodium system comprises equipment for melting, filtering and introducing sodium to the fill tanks. The half-inch globe valve at upper right is an inert gas line.

Photo 3) STOW flexible shafts control these 1½ inch diaphragm valves in the radioactive waste vault of the Sodium Reactor Experiment. The liquid waste disposal system is designed to dispose of the effluent from the fuel cleaning cells and the hot cells.

For complete information on these controls, write today for Design Manual 553.

STOW MANUFACTURING COMPANY

181 Shear St., Binghamton, N. Y.

1901. Specs called for copper wire insulated with cotton tape, oiled linen and hornfibre.

The old transformers carried 160% rated load until their enforced retirement at the end of 1957.

Calendar of Events

May 12-16 — American Society for Metals, Southwestern Metal Congress and Exposition. Automobile Bldg, State Fair Park, Dallas, Texas. Details from ASTM, 7301 Euclid Ave, Cleveland 3, Ohio.

May 14-17—Society for Experimental Stress Analysis, Spring Meeting. Hotel Manger, Cleveland, Ohio. Details from Dr W M Murray, Box 168, Cambridge 39, Mass.

May 19-23 — National Safety Council, Safety Management Techniques training course. Details from Director of Industrial Training, NSC, 425 N Michigan Ave, Chicago, Ill.

May 26-27—Stanford Research Institute, Western Area Development Conference. Vancouver, B.C. Details from C L Hamman, Economics Research Div, Stanford Research Institute, Menlo Park, Calif.

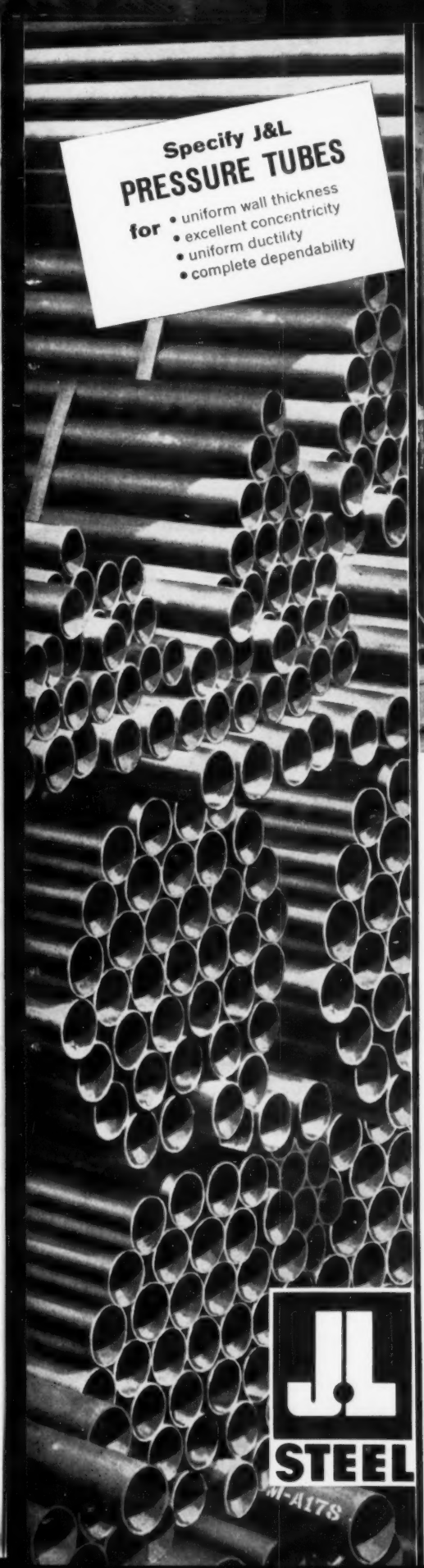
June 2-4 — Petroleum Electric Power Assn, 30th Annual Meeting. Texas Hotel, Fort Worth, Texas. Details: J P Maddox, New Mexico Electric Service Co, Hobbs, N. M.

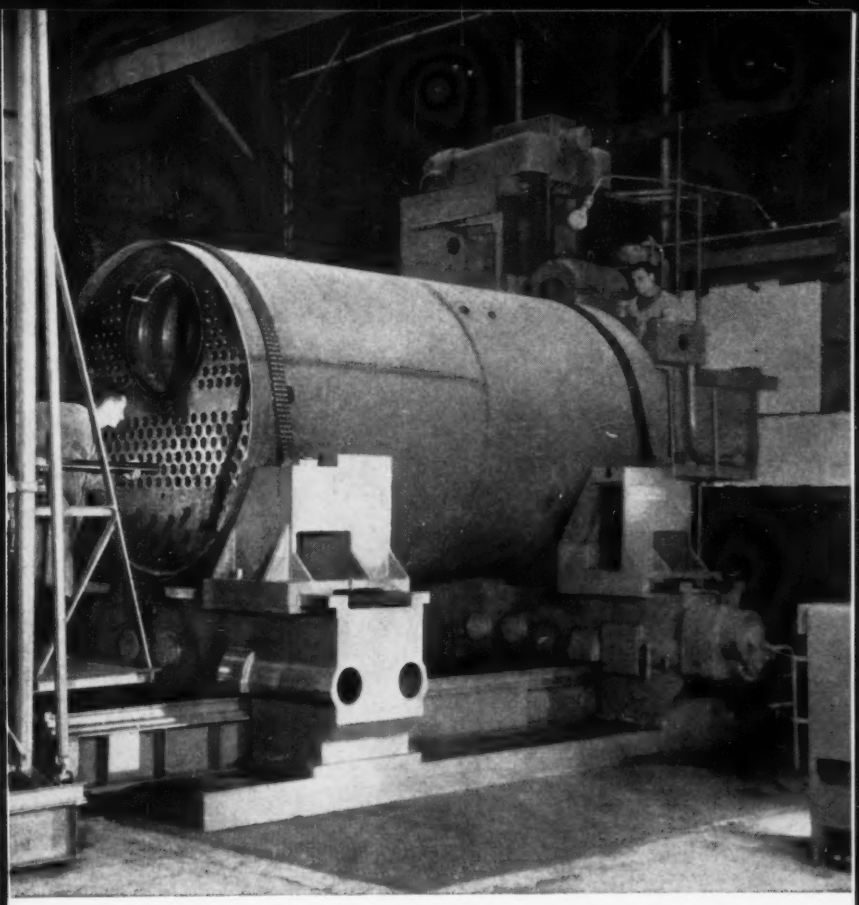
June 22-27—Pennsylvania State University, engineering seminar on Digital Design of Electrical Equipment. Penn State U. Details from D T Laird, Penn State U, University Park, Pa.

June 9-12—Edison Electric Institute, Annual Convention. Boston, Mass.

June 9-13—Oil-Heat Institute of America, Inc, convention and exposition. New York City, N. Y.

June 9-12—American Society of Mechanical Engineers, Materials Handling Conference in conjunction





J&L boiler tube uniformity speeds operations at Cleaver-Brooks

This unique "boiler-maker" at Cleaver-Brooks Company, Milwaukee, electronically drills tube sheets, rolls tubes into place, produces top quality packaged boilers. J&L boiler tube is used for this precision operation because of its concentricity, ductility and uniform thickness. Close tolerances make J&L boiler tube easy to work with minimum installation cost.

Jones & Laughlin, an integrated steelmaker, controls every step of production from iron ore to finished tubing. Most modern testing procedures at every step assure tubes with maximum strength and uniformity.

For your next order, specify J&L boiler tubes for top quality and performance. Write for the name of your nearest source, or for information on your specific requirements, to Jones & Laughlin Steel Corporation, 3 Gateway Center, Pittsburgh 30, Pa.

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Wire-inserted woven asbestos and spiral wound metal-asbestos—for manholes, handholes and tube caps of all makes of stationary and marine boilers, water walls, economizers and other boiler accessories.

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Such leading Packing Distributors as:

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BELMONT

Reports from the field

Begins on page 144

with National Materials Handling Exposition. Public Auditorium, Cleveland, Ohio. Details from ASME, 29 W 39th St, New York 18, N. Y.

June 9-13—Fourth International Automation Exposition. The Coliseum, New York City, N. Y. Details from Richard Rimbach Asso, Management, 845 Ridge Ave, Pittsburgh 12, Pa.

June 15-19 — American Society of Mechanical Engineers, Semi-Annual Meeting. Hotel Statler, Detroit, Mich. Details: ASME, 29 W 39th St, New York 18, N. Y.

June 22-27—Pennsylvania State University, seminar on Creative Engineering. Penn State U. Details: Prof Gjesdahl, Penn State U, University Park, Pa.

June 22-27—California Institute of Technology, Management Development summer conferences. Caltech campus. Details from M Gordon, Associate Director, Management Development Center, Caltech, Pasadena, Calif.

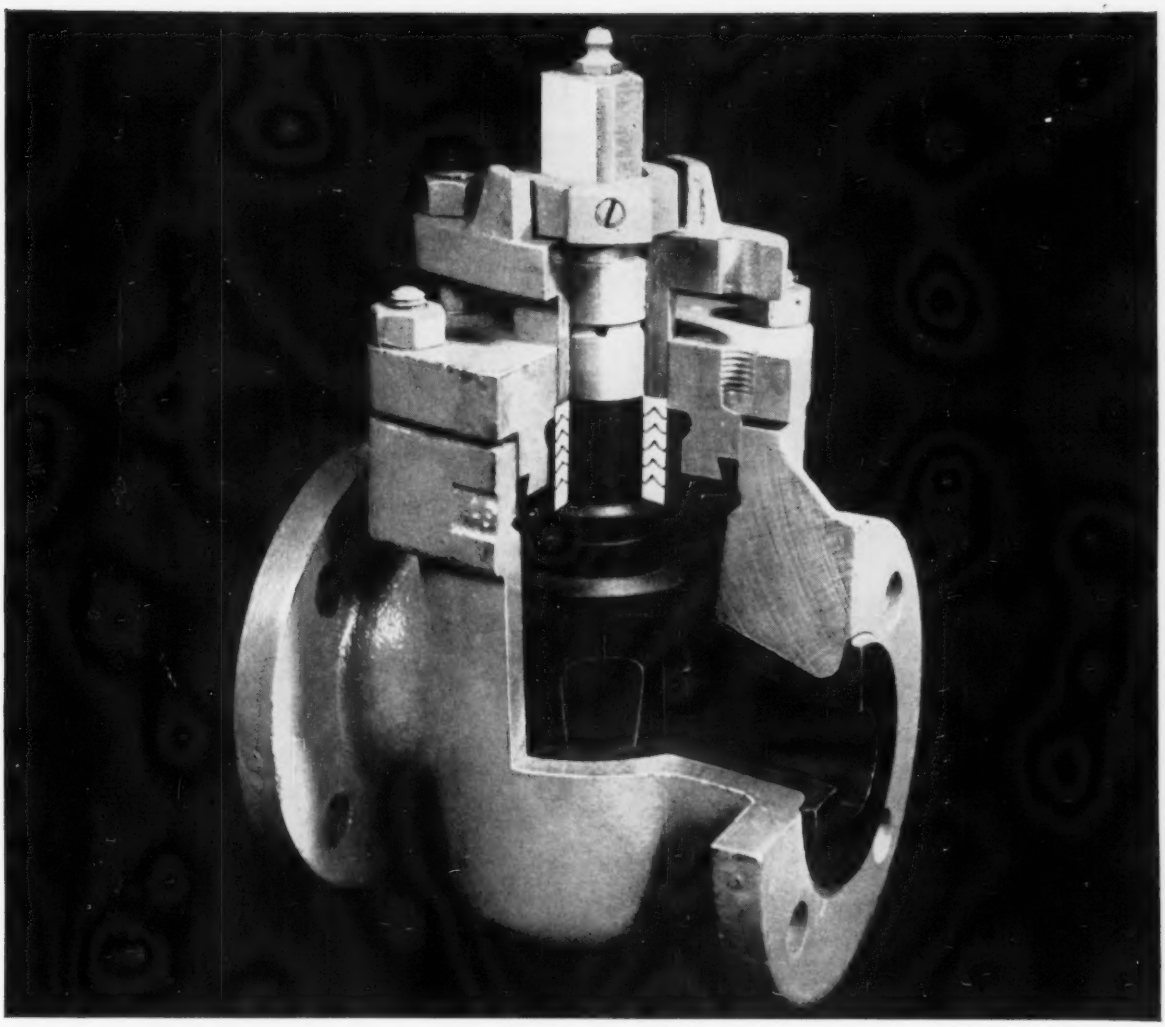
June 23-25 — American Society of Heating and Air-Conditioning Engineers, Inc, and **American Society of Refrigerating Engineers.** Leamington Hotel, Minneapolis, Minn.

July 7-11—University of Michigan, summer courses in Gas turbines and free-piston engines. Details from U of Michigan, Engineering Summer Conference Office, 2038 E Engineering Bldg, Ann Arbor, Mich.

July 8-12—Massachusetts Institute of Technology, summer program in Electrical energy conversion and control. Details from MIT, Cambridge 39, Mass.

Electricity protects lock, gates of Canadian canal

Electricity is working to prevent corrosion in one of Canada's newest



Here's why Saran Lined Pipe prevents water contamination

Highly reactive demineralized water will not react with the new gray saran lining

Water contamination in a power system can be costly. Mineral deposits from contaminated water can do thousands of dollars' worth of damage to expensive power generating equipment. That's why economy-minded power engineers are specifying complete saran lined piping systems and Saraloy® 898 tank linings.

Tough, corrosion-resistant saran is an inert material that won't react with demineralized water. Pipe, valves, pumps and fittings lined with the new gray saran permit design of complete piping systems for operations from full vacuum to 300 psi and temperatures from -20° F. up to 200° F. Saran Lined Pipe is safe, having the strength of its steel casing. Its design permits fabrication of joints in the field. Saran Lined Pipe, valves, pumps, fittings and Saraloy 898 tank linings are available for immediate shipment.

Write today for more information on why you should specify a complete piping system lined with saran and Saraloy 898. THE DOW CHEMICAL COMPANY, Midland, Michigan.

SARAN LINED PIPE COMPANY
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2415 BURDETTE AVENUE
FERNDALE 20, MICHIGAN

Please send me information on: ☐ Saran Lined Pipe, fittings and valves ☐ Saran lined centrifugal pumps ☐ Saraloy 898 chemical-resistant sheeting

Name _____ Title _____ Company _____

Address _____ City _____ State _____

YOU CAN DEPEND ON DOW

new STRONG
ductile iron steam traps
give you cast steel service
at less than half the price!*

Strong's new 540 series Hydro-Flex Steam Traps are made of DUCTILE (NODULAR) Iron that can be bent or twisted without breaking. This newest metallurgical development, adopted by ASME*, enables Strong to produce traps for service up to 500 psi and 650°F with ample safety factor. Ductile Iron economy permits sale of these traps at less than half the price of comparable cast steel traps.

*Ductile (Nodular) Iron meets the requirements of the ASME Code for use in vessels at pressures to 1000 psi and temperatures to 650°F (80% of cast steel service).

1. Safer to use because Ductile Iron body and cover will bend or twist in case of explosion or fire whereas brittle materials might shatter or break.

2. Especially recommended for drainage and drip service on high pressure steam systems and on both high and low pressure systems in chemical plants and refineries where steel is normally required.

3. Wide choice of sizes and capacities: Pipe sizes from ½" to 2", capacities to 42,800 pounds of water per hour.

4. Connections: Traps with screwed connections regularly furnished. (Although Ductile Iron can be welded or brazed under controlled shop conditions, welding is *not* recommended for field fabrication.)

Strong 540 Series Ductile Iron Traps are available from your local Strong Distributor. Call him for more information, or contact . . .

4/S STRONG, CARLISLE & HAMMOND
1392 WEST 3rd STREET • CLEVELAND 13, OHIO
air traps • strainers • reducing valves • vacuum or pumping traps
continuous blowdown valves • separators • engine stops • F and T traps

Begins on page 144

ship canals. In a report to the AIEE, T R B Watson of Corrosion Service, Ltd of Toronto described cathodic protection of lock and gates of the ship canal bisecting the Canso Causeway linking Cape Breton Island and the Nova Scotia mainland.

Because of a difference in water level on each side of the causeway, a ship canal with a lock had to be provided. A cofferdam on each side of each gate allows the whole gate to be unwatered for repairs or maintenance. Sheet-steel dam is anchored on each side of the canal by anchor piles which must be capable of resisting a pull of about 1000 tons when cofferdam is in place, so not even slight corrosion can be tolerated.

Electrical equipment was designed to supply up to six milliamperes per sq ft of underwater surface, although much lower current densities should be sufficient at the beginning. Engineers plan to raise amperage gradually as original bituminous "cold" coating deteriorates over the years. Maximum power cost is expected to be about $70 per year.

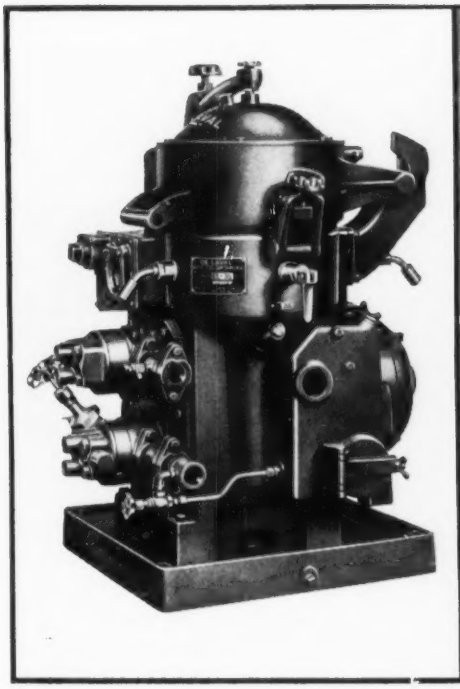
Mobile diesel-compressors help fuel Army missiles

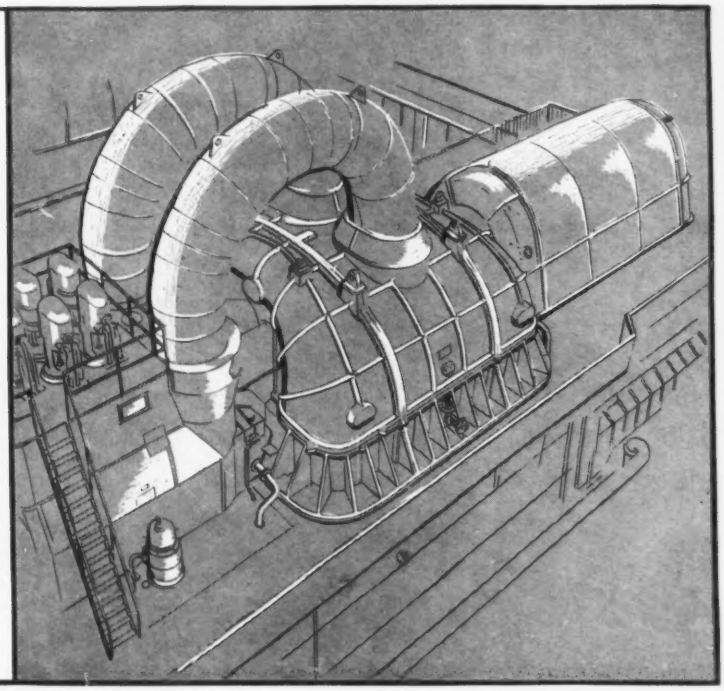
One of the world's most powerful trailer-mounted diesel-compressor plants will be used to supply fuel for Army missiles in the field. Two compressor vans plus two processing units make up a self-sufficient liquid-oxygen (LOX) plant capable of producing 20 tons of 99.5%-pure LOX per day.

The million-dollar plant solves one of the Army's toughest logistical problems—supply of missile fuel to launching sites. A missile must carry its own huge supply of oxygen for combustion. A light-blue liquid, produced and handled at –297 F, LOX has 600 to 800 times the combustion power of gaseous oxygen.

Plant for producing the LOX is

Bearing failures due to contaminated lubricating oil just don't happen when there's a De Laval Oil Purifier installed in the turbine lube system. The De Laval Purifier, operating full-time or only when you judge it necessary, continuously and completely removes water, sludge and all foreign matter from the oil.





De Laval . . . the lowest-cost insurance you can buy against costly turbine damage or downtime

Purification is so complete that turbines have frequently been left on line for extended peak periods after water leaks had been discovered . . . until it was practical to shut down for repairs.

With a De Laval on the line, you're 100 per cent insured against any kind of turbine damage caused by contaminated lube oil. And there's absolutely no loss of additives, inhibitors or detergents. Write for Bulletin S.A. 984 which describes typical installations, gives capacities and specifications.

DE LAVAL
SEPARATOR COMPANY

THE DE LAVAL SEPARATOR COMPANY
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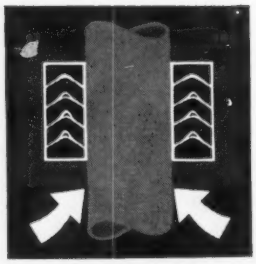
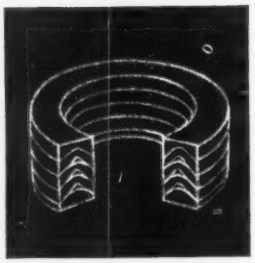
201 E. Millbrae Avenue, Millbrae, Calif.

WHERE A TIGHT SEAL IS DIFFICULT



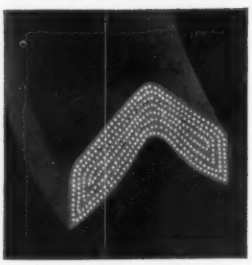
It is increasingly difficult to get a tight seal without undue friction, under the extremes of heat and pressure common in today's industry.

SCIENTIFIC DESIGN IS A MUST



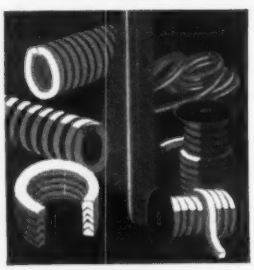
R/M Vee-Flex® Packing Rings can withstand the high pressures and temperatures that meet your specific need. Unique design seals in pressure, reduces friction.

R/M PROVIDES PRECISION MOLDING



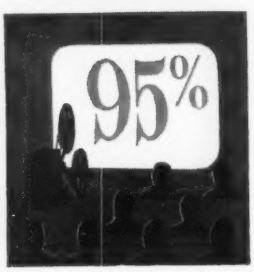
Precision molding means more accurate fit. Thorough penetration of compound gives better pressure resistance, longer wear.

VEE-FLEX IS ONE OF THE 7 BASIC TYPES



Big 7 Packings give custom-built performance in 95% of your packing applications, eliminate stocking problems, lower maintenance costs, cut downtime, permit preventive maintenance. They are sold only through authorized R/M distributors.

PACKING CLINIC GIVES FULL DETAILS



Color movie is part of R/M Packing Clinic. Learn how three or four R/M Big 7 Packing Types may meet 95% of your needs. Ask your authorized R/M distributor for a showing!

R/M

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RAYBESTOS-MANHATTAN, INC.
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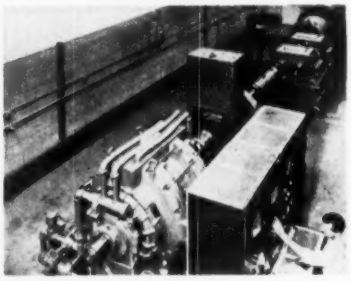
Reports from the field

Begins on page 144

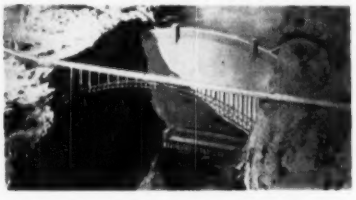
packed into four semi-trailers, each 30x8x11 ft. Fairbanks-Morse & Co produced the air-supply units, which include a complete heavy-duty diesel power plant and a compressor to deliver large quantities of air at 100 psi.

Engine used is an 8-cylinder opposed-piston diesel rated at 1200 hp at 1200 rpm. Compressors are two-stage screw-type units recently introduced to the U.S.



Automation comes to the dynamometer

A fully automatic 1000-hp dynamometer has been installed in the research and development laboratories of the Twin Disc Clutch Co at Rockford, Ill. Function plotters automatically draw performance curves of test units installed on the test plate as the giant machine is operated through a series of rapid changes in input speed and horsepower.

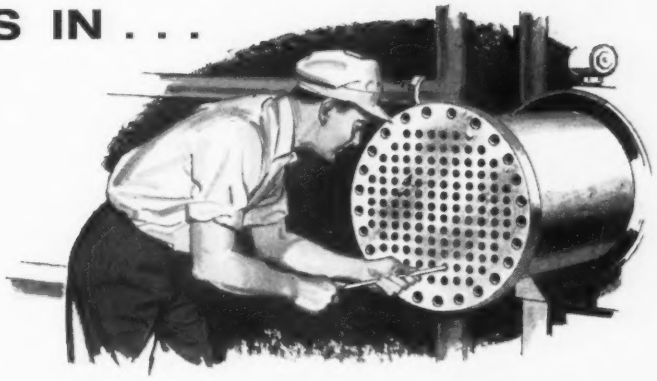


Glen Canyon will be world's third-highest arch dam

Glen Canyon Dam in Arizona, 13 miles downstream on the Colorado River from the Arizona-Utah state line, is the largest single construction project in the history of the U.S. Bureau of Reclamation. The $107,900,000 dam being built by Merritt, Chapman and Scott will be a concrete arch 700-ft high with a 1500-ft crest length.

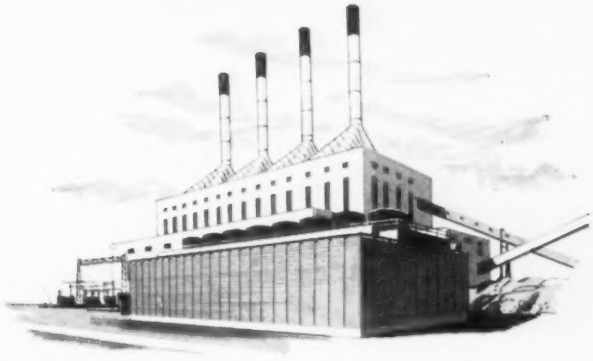
Dam will contain 4,770,000 cu ft

WATER PROBLEMS IN . . .



heat exchangers?

pipe lines?



cooling towers?

CALGON HAS THE ANSWER

Corrosion and other water damage to key points in cooling and service water systems can tie up an entire plant. Costly equipment can be damaged beyond repair. Replacement costs and the losses caused by unscheduled outages far outweigh the modest cost of adequate protection.

Call on Calgon Engineering Service to insure protection of the entire system. From cooling towers on through, the Calgon engineer can save you money and time. Experience with every type of water problem in all parts of the country, backed by complete laboratory facilities, is at your service.

Corrosion control with Calgon* is only one of the many services available. A letter or phone call will bring a man with the water problem answers to work for you.

*Calgon is the Registered Trademark of Calgon Company for its sodium phosphate glass (sodium hexametaphosphate) products. The use of polyphosphates for the prevention of corrosion is covered by U. S. Patent 2,337,856.

CALGON COMPANY

DIVISION OF **HAGAN** CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO

HERE'S ANOTHER TESTIMONIAL TO LONERGAN VALVES

"We are pleased to advise that over the past year or so we have reconditioned a large number of your series 41-W-200 and 11-W-200 safety valves for our customers.

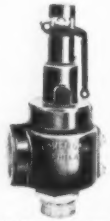
"We have been very favorably impressed with the mechanical integrity of these valves and the excellent economical service these valves are giving."

HENZE INSTRUMENT & VALVE INC.

SERIES 41-W-200

High capacity per size. Top Guided. Two Control Rings. Free-acting, self-aligning disc • a "floating" guide (readily adjustable for control) . . . assists in opening and closing action, as well as affording an additional self-aligning feature • a Disc and Disc holder of forged copper alloy, not castings. Available in sizes from 1½" through 6", Lonergan UNI-LINE Valves are A.S.M.E. and National Board approved design.

Small size, high capacity, Top Guided Valve with Screwed Inlet, of same features as Flanged Valve. Available from ¾" to 3" inlet size. A.S.M.E. and National Board approved.



SERIES 11-W-200

Write for details on these and others of the complete line of LONERGAN Valves and/or Gauges.

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Reports from the field

Begins on page 144

of concrete and form a reservoir 186 miles long with a maximum capacity of 28-million acre-ft. It will be the key structure in development of land and water resources of the 10,000-sq mile Upper Colorado river basin.

A power house below dam will have eight 155,500-hp 510-ft-head 150-rpm francis turbines, giving plant a total capacity of 1,244,000 hp. Glen Canyon will be one of the world's highest arch dams, exceeded only by the 726-ft Hoover Dam, also on the Colorado, and Mouvoisin Dam. 780-ft high, recently completed in Switzerland.

Engineers flock to valve seminar

Power engineers from all over the country attended a special seminar on "Meeting the challenges of tomorrow's high-pressure era." The all-day event was sponsored by Edward Valves, Inc, subsidiary of Rockwell Mfg Co, at the East Chicago, Indiana plant on March 23, 1958. The program included an extensive tour of their plant and recently expanded research laboratory.

Highlights included presentation of "The case for a 4500-psi industry standard" by W F Crawford, president of Edward Valves. This is the same valve standard recently proposed by Mr Crawford in December POWER. The day was climaxed by a banquet at which W F Rockwell Jr, President of Rockwell Mfg Co, and POWER's L N Rowley were the principal speakers.

First research reactor to be installed in a Latin American nation, built by Babcock & Wilcox Co, is now operating in Brazil.

Floods coming? Reprints of 7-page article from April POWER will help before and after disaster strikes. Write, phone or wire for your copy now.

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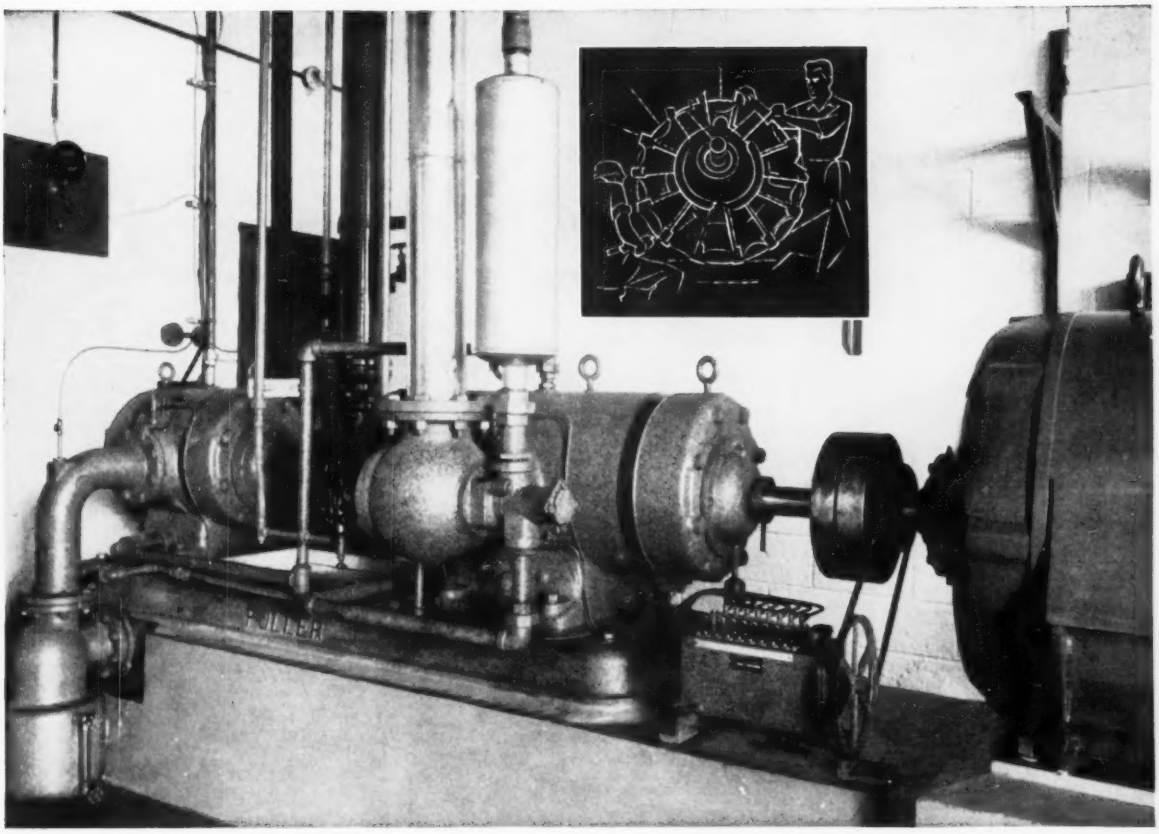

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Here's what the Vice President-Operations of Airwork Corporation, one of the nation's leading aircraft overhaul companies, writes about Fuller Model C-150-150H Rotary Air Compressors.

"We were running out of air capacity, and had decided that we would like to get rid of the maintenance problems inherent in a piston type air compressor.

"The Fuller compressor with its fewer moving parts and favorable price range met our basic requirements.

"We then checked on Fuller compressor performance through our close contacts with a leading manufacturer of aircraft engines. Their opinion was very favorable. We think Airwork has made the right decision."

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- Wide seal between rotor and bottom of cylinder, assuring high volumetric efficiency.
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- Compact space-saving installation.
- Simple foundation.
- No valves to leak or seats to grind.
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Bookshelf

Progress in Nuclear Energy—Series II—Vol I—Reactors. *Edited by R A Charpie, Oak Ridge National Laboratory, D J Hughes, Brookhaven National Laboratory, D J Littler, Harwell (England), M Trocheris, Saclay (France). 9¼ x 6¾, 492 pp, illust, tables, $14.00. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

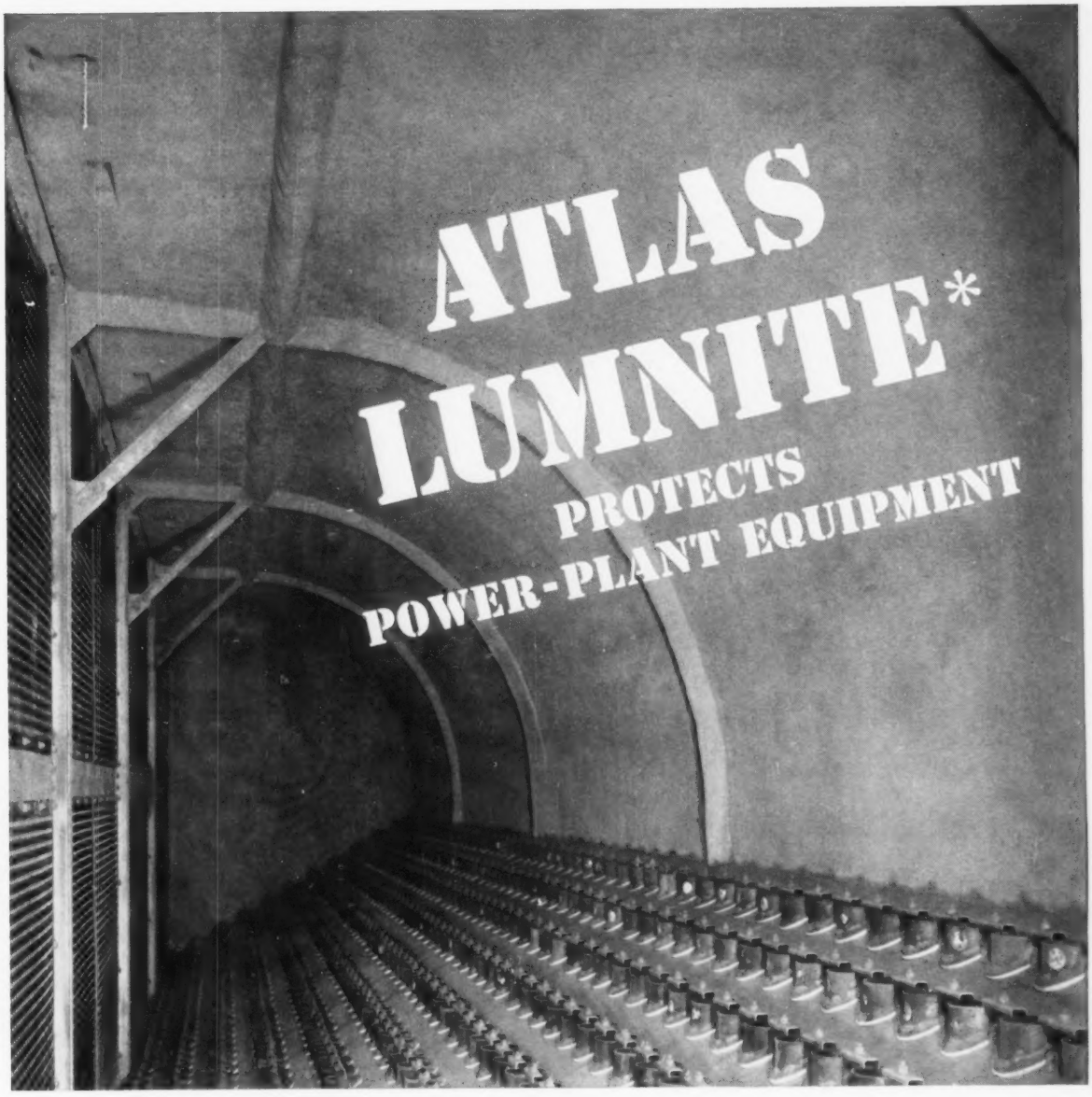
This is one of the books in the series called "Progress in Nuclear Energy" which consists of 8 series; these cover all aspects of atomic science. This book gives a series of review papers on the present state of the art of reactor design in all parts of the world including the U.S.S.R. Chapter headings give a good idea of the book's contents: Canadian research reactors; U.S. research reactors; Soviet research reactors; European research reactors; UK research reactors; pressurized-water reactor power plant at Shippingport, Pa; design and operating experience of a prototype boiling-water power reactor; aqueous homogeneous power reactors; graphite-moderated gas-cooled pile and its place in power production; sodium-cooled graphite reactor; review of fast power reactors; catalogue of nuclear reactors.

The book is largely descriptive with a minimum of advanced mathematics. Many photographs of reactors and their components are included. A readable book.

Control of Nuclear Reactors and Power Plants. *By M A Schultz, Westinghouse Electric Corporation. 9¼ x 6¼, 313 pp, illust, $7.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

The book approaches the problem of nuclear reactor control from the viewpoint of servo engineering. Design type charts and graphs form the basis of the presentation. Discussion centers on the interrelationship of physics, servo engineering and thermodynamic requirements of a nuclear control system. From these, develop the elementary control concepts and definitions.

Author interprets the responses of nuclear reactors in engineering terminology; then they are treated as control elements in larger control systems. The book investigates several



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Bookshelf

Begins on page 218

types of control systems for research and power reactors.

Operating control problems during startup, power-level operation, and during shutdown get special attention. Simulator design, to check control devices and systems in the laboratory without using a reactor, is also covered. Other topics discussed include: servo treatment of the problems of negative-temperature coefficient feedback and xenon feedback; transient response and stability of reactor control system; nuclear power plant programming; transient response and stability criteria for complete power plants; required rates of reactivity change for various startup, operation, and shutdown situations; nuclear power plant simulation by analog techniques.

Symposium on pH Measurement (ASTM Special Technical Publication 190). *104 pp, illust, 6 x 9, paper cover. $2.50. American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.*

This second symposium was arganized and published to keep pace with rapid advances made in recent years in the field of pH measurement.

Topics of interest to process and control engineers include: (1) meaning and standardization of pH measurements (2) performance studies of reference-electrodes and their components at high temperatures and pressures (3) modern developments in pH instrumentation. Many other special applications of pH are also discussed in detail. The volume is well illustrated and includes several extensive bibliographies.

pH measurement and control plays an increasingly important role in the operation of today's power plants. This should be a valuable reference work for those engineers responsible for pH instrumentation.

Standard Handbook for Electrical Engineers (9th Ed.) *Prepared by a staff of specialists. Archer E Knowlton, Editor-in-Chief. 2230 pp, illust. $19.50. McGraw-Hill Book Co. 330 W 42nd St, New York 36, N. Y.*

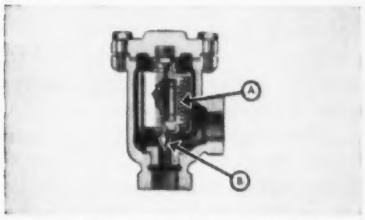
This ninth edition of the famous standard reference book is a thor-

Full-range steam traps cut high cost of steam pressure variations

By John W. Ritter, Test Engineer
SARCO Company, Inc.

While boiler room economics dictate that boiler pressures remain constant, the equally sound economics of batch processing may decree that pressures at the equipment vary with the requirement of the process. The attempt to choose a steam trap that is all things to all conditions may result in installing traps that operate inefficiently at either extreme of their pressure range or that require adjustment every time the operations sheet calls for another pressure-temperature setting. Orifice traps represent a somewhat more rational approach to the problem, but often at the price of a continuous discharge of steam, particularly at the low pressures of start-up and shut down. Compromise, adjustment, and steam waste all spell inefficiency in the utilization of steam.

Production-Planned steam trapping, on the other hand, improves efficiency by the use of properly designed and installed thermostatic steam traps. Such traps employ the expansion and contraction of a thermostatic element to operate the discharge valve.



In Sarco Thermostatic Steam Trap, element (A) expands at steam temperature to close valve (B), contracts to permit discharge of condensate.

In the Sarco "Balanced Pressure" Thermostatic Steam Trap a volatile fluid is sealed inside a metal bellows that opens or closes the valve as it contracts or expands with condensate temperature. Near steam temperature, evaporation of the fluid creates an internal pressure greater than steam pressure in the trap body, and the expanding bellows seats the valve. When the condensate cools, the element contracts and opens the valve.

It is evident that at steam temperature pressure inside the element is higher than steam pressure, no matter how the latter may vary. Thus, the trap compensates automatically for variations in pressure.

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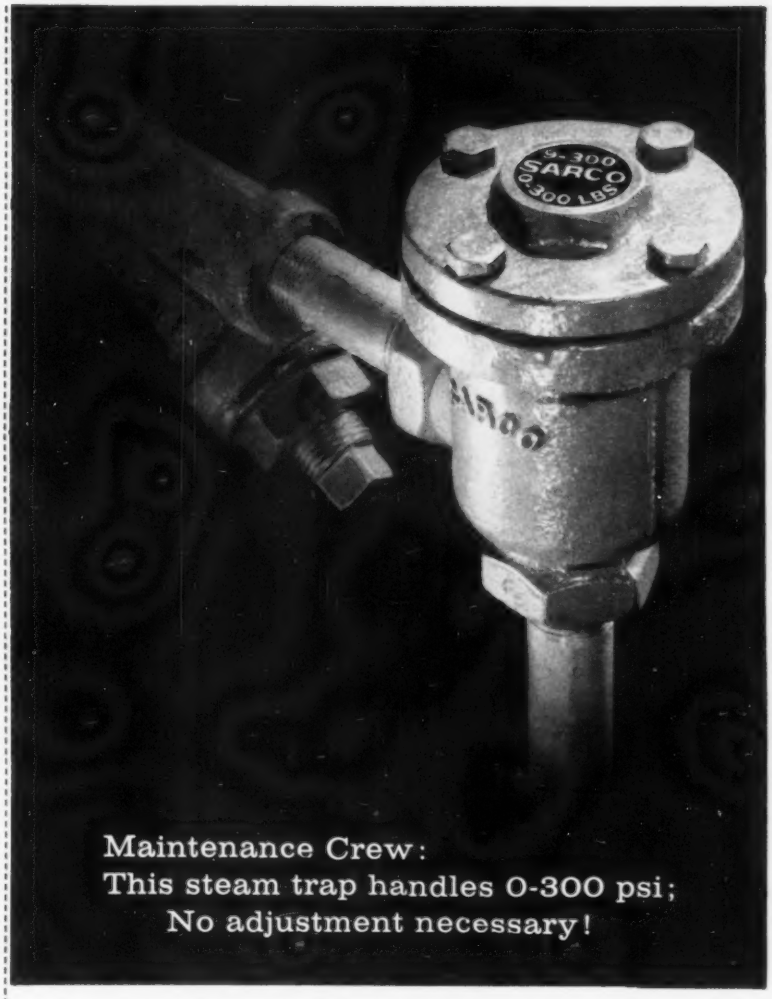

Sarco "Balanced Pressure" Thermostatic Steam Traps cut trap maintenance costs and simplify parts inventory. Why? Because the same bellows, head and seat handle steam pressures up to 300 psi – without any need of adjustment for variations in load or pressure.

Other advantages: unmatched capacity/cost ratio (1" size discharges 9,650 lbs/hr. at 10°F below steam temperature, 125 psi). This trap can't air-bind and, when installed with free discharge, can't freeze.

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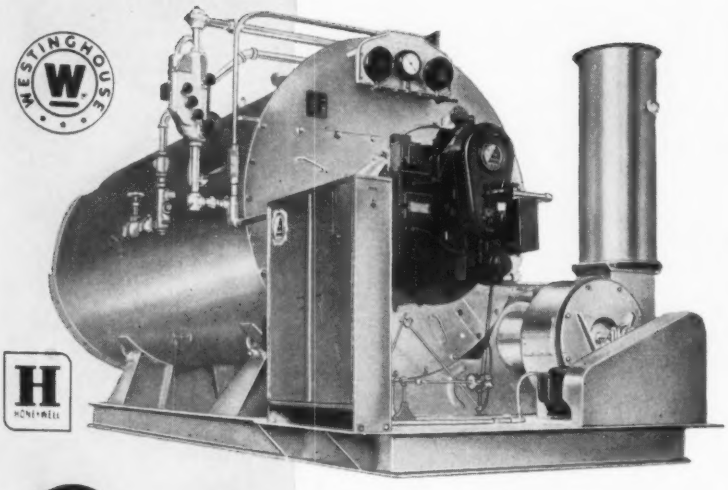

When spending is down, the trend is to the purchase of quality equipment which, though higher in price, assures more economical operation and less maintenance, hence lower eventual cost.

Concerns such as those identified here, consistently select the very best in equipment, material and personnel to provide their customers with better products and assure their own high standing. To these concerns the PREFERRED Unit Steam Generator is an acknowledged leader in package boiler design, construction and performance—an investment that truly pays off.

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Bookshelf

Begins on page 218

ough revision of the eighth (1947) edition. Some of the areas in which new or extended material has been included are: transistors, nuclear power, new dielectrics for capacitors, new synthetic resins and plastics, electrical measurements for automation, new lighting data, advancements in power cable, telemetering, magnetic amplifiers in motor control. As in previous editions, the various sections of the book have been written or revised by recognized experts in that particular branch of electrical engineering.

Mechanical Engineering Laboratory — Instrumentation and Its Application. *By J S Doolittle, professor of mechanical engineering, North Carolina State College. 6¼ x 9¼, 396 pp, illust, tables, $6.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

Subject matter of this book is grouped in three major parts: (1) instrumentation (2) physical and chemical properties of fuels and lubricants (3) engineering experimentation. The author develops the book on the premise that reporting on instrumentation and on main equipment requires different techniques. The first part outlines the methods of investigating and reporting on instrumentation; the third part outlines how instruments are used to find machine performance characteristics. The second part demonstrates how some test codes of ASTM and ASME are used to find fairly complex properties of fuels and lubricants.

Areas covered under instrumentation include: pressure, temperature, area, speed, weight, volume, power, vapor state, humidity and combustion products.

Topics discussed under fuel and lubricant testing include: sampling, analysis, ash tests, density, gravity, flash and fire points, viscosity, distillation, fuel heating values, calorimeters.

Under engineering experimentation the book covers: preparation and making tests, analyzing data, writing the report, measuring fluid flow, fluid friction and heat transfer.

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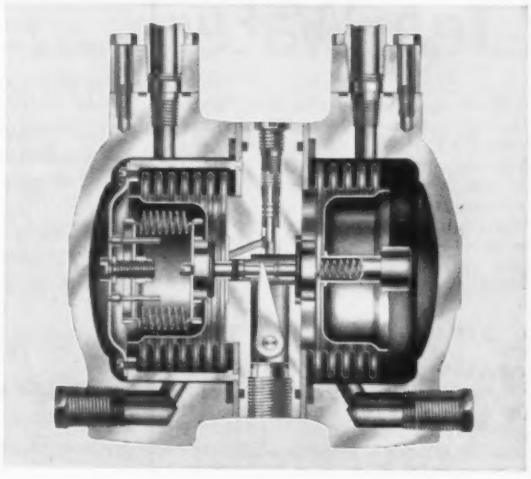

Some of its outstanding features:

Sensitive and accurate—Sensitive to within 0.05% of full scale ... calibrated accuracy ±0.5% of full scale.

Leakproof—Between liquid fill and process fluid.

Automatically stabilized—Changes in meter body temperature or static pressure have no effect on output shaft position. The Honeywell Bellows Meter operates efficiently in surrounding temperatures of minus 40°F to plus 250°F.

Unmatched convenience features—Including fast range changing in the field ... connections for both horizontal and vertical piping ... quick calibration and adjustment ... easy cleaning and servicing.

High corrosion resistance—Seamless, stainless steel formed bellows give long, trouble-free service with virtually all process fluids.

Fast, effective damping adjustment—New type pulsation check with rectangular orifice enables essentially linear damping adjustment ... and you can adjust from outside the meter body during operation.

Models are available in many ranges, for both flow and liquid level measurement and control. Get details on *all* the features of the new Honeywell Bellows Meter by calling your nearby Honeywell field engineer today ... he's as near as your phone.

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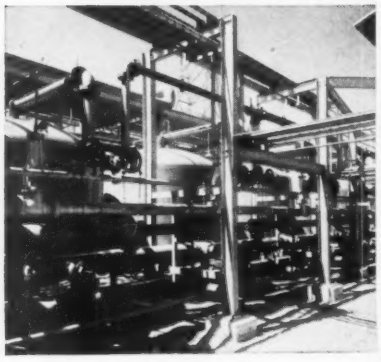

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Appointments

Corporation changes

Midwest Piping Co, Inc: O P Carter, president. **Iron Fireman Mfg Co:** Richard C Wright, vice-president. **Simpson Electric Co:** J R Whiteside, president. **Lima Electric Motor Co, Inc:** Patrick F Dwyer, Burt F Wyandt, vice-presidents.

Engineer changes

General Electric Co, Vallecitos Atomic Laboratory: Samuel Untermyer II, consulting engineer, reactor technology; Edward P Lee, reactor operations manager. **Dodge Mfg Corp:** Alex T Bodle, consulting engineer; Jackson Chung, chief engineer; Donald P Lower, manager of engineering.

International Nickel Co, Inc: Development and Research Div: Ludwig Anselmini, engineer. **Henry J Kaiser Co,** Kaiser Engineers Div: J Frank Henderson, development engineer. **H K Porter Co, Inc,** Quaker Rubber Div: S William Riley, chief project engineer.

General sales manager

Solar Aircraft Co: William F Briney, manager of industrial products sales. **Eclipse Fuel Engineering Co,** Industrial Combustion Div: Erwin E Hirschberg, sales manager. **Olin Mathieson Chemical Corp,** Olin Aluminum Div: John M Welch, director of field sales.

District sales manager

Reliance Electric & Engineering Co: Elwood H Koontz, central-west region; Andrew C Perrin, western region. **Dayton Rubber Co,** Industrial Wholesaler Div: W F Monahan, New York; Thomas Dunlap, Pennsylvania; Harry Day Jr, Texas. **Nordberg Mfg Co,** Engine Div: Philip Wallach, Great Lakes.

New district offices

Sparling Meter Co, Inc: at 1690 Milwaukee Ave, Denver 6, Colo. **Mann Engineering Co:** at 21038 Southbend Circle, Cleveland, Ohio.

(*Continued on page* 226)

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PERFECT SEAL
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HOT FORGED from solid, rectangular steel bars, designed and produced for dependable, long-life service under the severest piping conditions!

A TYPE FOR EVERY USE!
FOR ALL PRESSURES!
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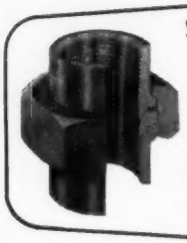

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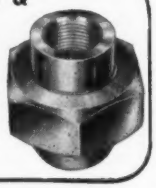
With screwed or socket weld ends. 3000-lb. and 8000-lb. service.



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THAT FRUSTRATED FEELING . . .

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Modern DETROIT STOKERS under your present boilers will give you more steam at lower cost

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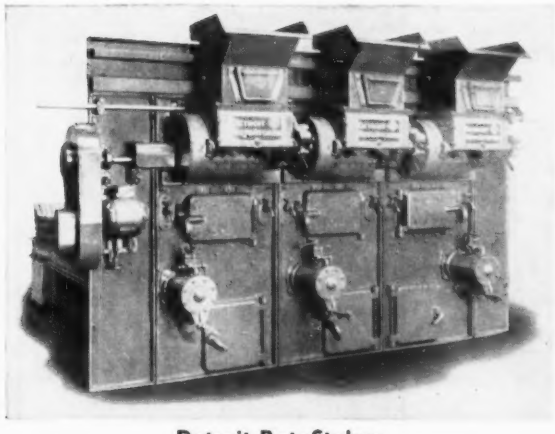

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There is a type and size of Detroit Stoker for any industrial or power need—3000 to 400,000 pounds steam per hour boiler capacity.

Detroit Stokers are available to burn all ranks of bituminous coals and lignites . . . and many waste and refuse fuels.

Our 60 years experience can be invaluable to you in selecting a type and size to meet your requirements.

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Detroit Stokers cost less. Cost = initial investment + upkeep + production losses due to equipment outage. The total is less with Detroit.

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(up to 150 lbs. psi.)

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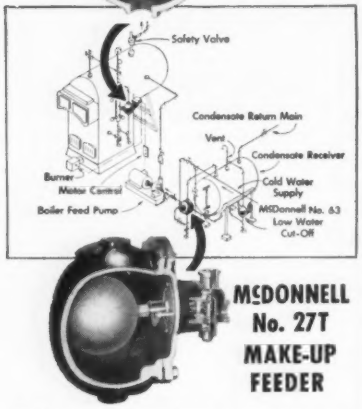
No. 150
PUMP CONTROL



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Doing One Thing Well
McDONNELL
Boiler Water Level Control
and Safety Devices

Appointments

Begins on page 224

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New representatives

For **Wing Mfg Co:** Brosey & Frew, Inc, Indianapolis, Ind.; Service Refractories, Inc, Peoria, Ill.; P R Deane Co, Geneseo, Ill. For **Associated Pipe & Engineering Co,** Temp Flex Div: Power and Thermic Specialties, 60 E 42nd St, New York City, N. Y. For **Hills-McCanna Co:** Kirk Campbell Co, 1785 Locust St, Kansas City 8, Mo.

New distributors

For **H O Trerice Co:** Roach Equipment Co, Inc, 801 W 23rd St, Tulsa, Okla. For **ACF Industries, Inc,** W-K-M Div: The Robert Muddiman Co, Canada. For **Automatic Switch Co:** Berkness Control and Equipment Corp, 615 E Franklin St, Richmond 19, Va.; Kelburn Equipment Co, 3136 S Clarence Ave, Berwyn, Ill.

Recent moves

Babcock & Wilcox Co: Boiler Div sales office to 1367 The Illuminating Bldg, 55 Public Sq, Cleveland 13, Ohio. **Walworth Co:** executive offices to 750 Third Ave, New York 17, N. Y. **Cummins & Barnard, Inc:** to 2058 S State St, Ann Arbor, Mich. **Water Service Laboratories, Inc:** New York office and lab to 615 W 131st St, New York 27, N. Y.

Retirements

Leonard W Towner, General Electric Co Pacific Southwest District lighting specialist, after 29 years.

Raymond W Hess, Coordinator of Pollution Research for Allied Chemical & Dye Corp, National Aniline Div, after 40 years.

Herbert E Barth, American Blower Corp executive vie-president, after 43 years.

NELSON COMPANY

STEAM FITTERS —
PIPING CONTRACTORS
ERECTORS & FABRICATORS
OF
CARBON — STAINLESS —
ALLOY — PLASTIC &
PVC MATERIALS

STEAM
PULP & PAPER MILLS
STEEL MILLS
GAS & WATER UTILITIES
CHEMICAL PROCESS SYSTEMS
REFINERIES
SEWAGE SYSTEMS

NELSON COMPANY
AMOSLAND RD. AT B. & O. R.R.
HOLMES, PENNA.
LEHIGH 2-7900

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Maybe we don't have your complete address.

A complete address includes a

Postal Zone Number

GRACE CHEMICAL CO., DIVISION OF W. R. GRACE & CO.

At its Memphis plant, Grace Chemical produces 300 tons of anhydrous ammonia per day. Three 4,000-h.p. compressors are the heart of this operation, each handling 3 different gases under varying intake and discharge conditions.

Fire-resistant PYDRAUL AC protects huge compressor operations at Grace Chemical Co.

Turning out 300 tons of anhydrous ammonia per day depends on reliable and SAFE performance of the compressors. That's why Grace engineers at Memphis take every precaution to insure continuous operation. They choose fire-resistant Pydraul AC to lubricate air compressors, minimize carbon deposits and thus reduce fire dangers.

Compressor fire and explosion dangers lurk in flammable lubricants and their residues deposited in compressed air cylinders and piping. Eliminate these dangers now in your compressors, any size, any make.

Conversion is easy . . . essentially, just drain your flammable fluid and replace with fire-resistant Pydraul AC.

Send the coupon for your copy of the new Pydraul AC booklet . . . for the answers to your compressor lubricant problems.

Organic Chemicals Division

MONSANTO CHEMICAL COMPANY

Dept. PO-1

St. Louis 24, Missouri

Pydraul: Reg. U.S. Trademark

Monsanto

WHERE CREATIVE CHEMISTRY WORKS WONDERS FOR YOU

Please send me the PYDRAUL AC booklet

Name..... Title.....

Firm.....

Address.....

City..... State.....

More power to you !

There are wide differences in coal; wide differences in plant equipment and operation. When the two are matched, they team up to "knock down" steam generating costs.

This match-making can best be accomplished with the help of Norfolk and Western coal consultants. Tell these men about your operation, and they will recommend a *Fuel Satisfaction** coal "tailored" to your needs.

From seam to steam, every precaution is taken in the production, processing and transportation of *Fuel Satisfaction* coals to assure a product of the highest quality and uniformity. Every load of this superior Bituminous Coal can mean . . . *more power to you!*

**Fuel Satisfaction* is the name given the many fine brands of superior all-purpose Bituminous Coal mined along the N&W.

Norfolk and Western RAILWAY

CARRIER OF FUEL SATISFACTION

For technical advice and assistance on utilization problems, consult with N&W fuel specialists. There's no obligation.

ROANOKE
N&W Coal Traffic Dept.
Telephone Diamond 4-1451, Ext. 313, 423, 249, 732
Roanoke, Virginia

BOSTON
833 Chamber of Commerce Building
Telephone Liberty 2-2229
Boston 10, Massachusetts

CHICAGO
Room 604, 208 South LaSalle Street
Telephone RAndolph 6-4634
Chicago 4, Illinois

CINCINNATI
913 Dixie Terminal Building
Telephone DUnbar 1-1325
Cincinnati 2, Ohio

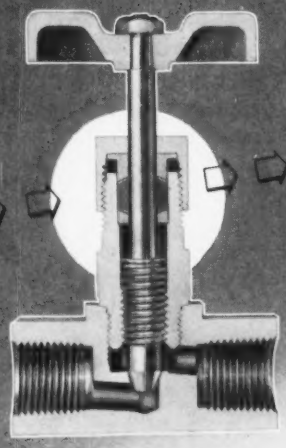
CLEVELAND
Room 722, The Illuminating Building
Telephone MAin 1-7960
Cleveland 13, Ohio

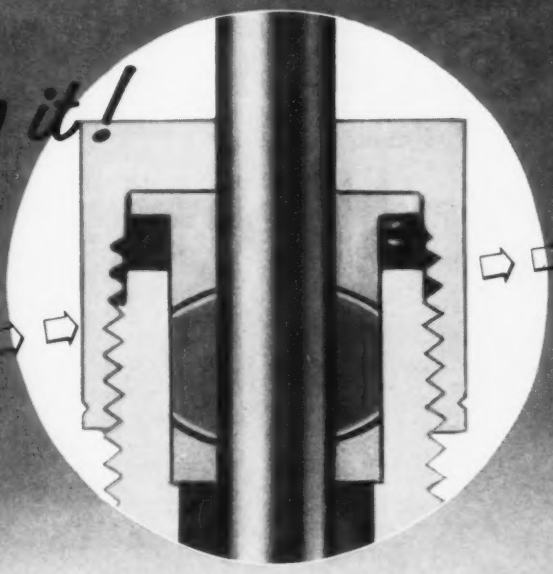
DETROIT
1907 Book Building
Telephone WOodward 1-2340 or 1-2341
Detroit 26, Michigan

ST. LOUIS
2059 Railway Exchange Building
Telephone MAin 1-1180
St. Louis 1, Missouri

WINSTON-SALEM
1105 Reynolds Building
Telephone PArk 2-7116
Winston-Salem 1, North Carolina

Marsh has it!





The Marpak Packing System

—*now with fabulous*

"TEFLON" PACKING

An outstanding feature of the Marsh Needle Valve has been the Marpak Packing System. This unique method of obtaining a tight, but non-binding seal is one of the important reasons for the ability of Marsh Valves to give precision regulation at any pressure up to 10,000 psi.

Now the Marpak system has been made still better by the use of today's miracle material—"Teflon." You probably know of the almost incredible toughness, resilience and non-adhesive properties of Teflon—properties that are unimpaired by the most powerful of solvents, acids, or alkalies, even at temperatures up to 500° F.! As a result of incorporating "Teflon" packing, Marsh Stainless Steel Needle Valves are now

Guaranteed for any pressure up to 10,000 psi at any temperature up to 500° F.

In other makes of valves permissable temperature *decreases* as pressure *increases*—but not with Marsh.

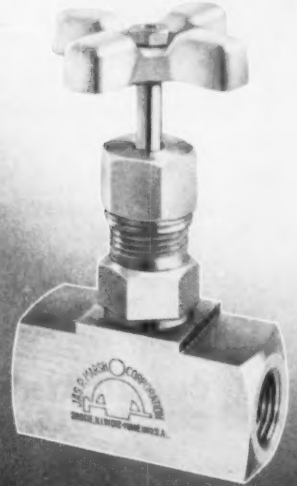
Teflon packing is one more addition to the list of features that are combined only in Marsh Stainless Steel Needle Throttling Valves. Note the list opposite...ask for bulletin.

Available in MARSH

416 Stainless Steel

Needle Throttling Valves

- Body and stem guide machined from bar stainless steel stock
- Valve Stem hardened stainless
- Fine stem threads for extra strength and precision throttling
- Deeper inlet and outlet chambers
- Bodies made in accordance with MSS regulations
- Packing "Marpak" system incorporating "Teflon" as described opposite



MARSH INSTRUMENT CO. *Sales Affiliate of Jas. P. Marsh Corp.*, **Dept. F Skokie, Ill.**
Marsh Instrument and Valve Co. (Canada) Ltd., 8407 103rd St., Edmonton, Alberta
Houston Branch Plant: 1121 Rothwell St., Sect. 15, Houston, Texas

Hagan cuts dust collection costs

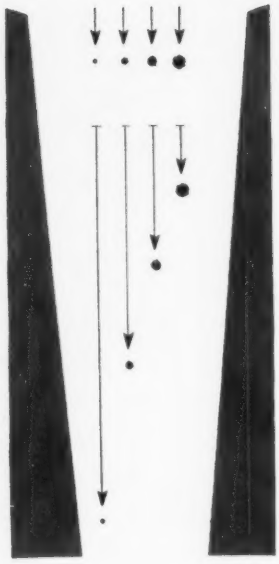


Diagram shows how the Hagan principle of Selective Particle Acceleration works. Venturi effect of individual inlets accelerates gases on a 6 to 1 ratio. The larger, most abrasive particles pick up the least speed — smaller particles are accelerated the most. All are efficiently separated, but wear on tubes is sharply reduced.

The reasons why the principle of Selective Particle Acceleration enables Hagan to *guarantee* superior efficiency and economy in their Aerostatic Dust Collector are explained in detail and illustrated in a new Bulletin — MSP-124 A.

Designed to produce high efficiency with minimum erosion and draft loss, the Hagan collector more than meets current and contemplated air pollution codes for coal fired boilers.

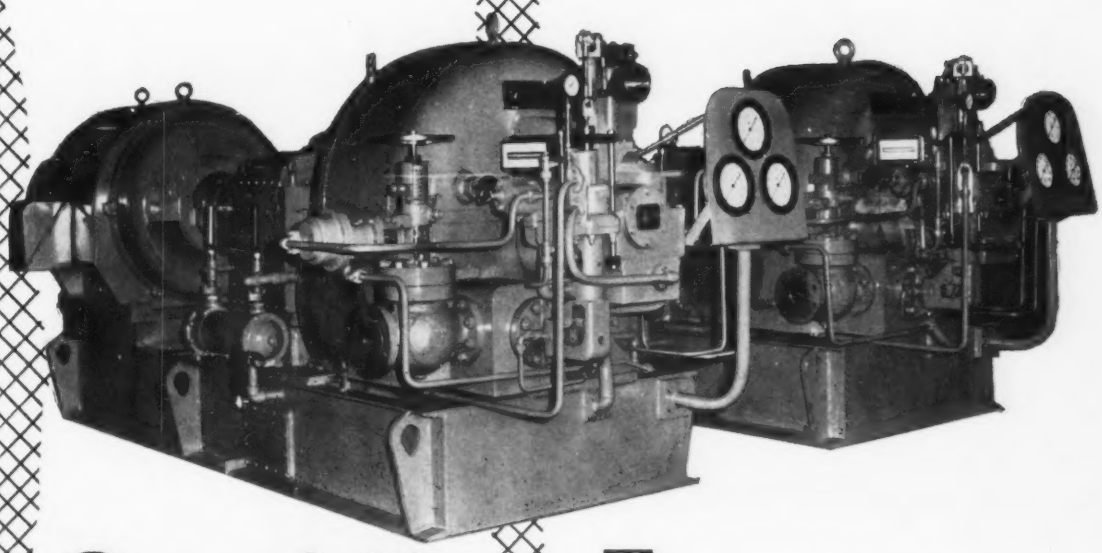
The Hagan collector has useful application in the field of product recovery, where optimum efficiency *improves* your *product* and *profit yield!* In many cases, the Aerostatic collector will more than pay for itself in a short time and continue to yield profits.

Here is a *bonus!* Units are shipped pre-assembled. Installation is easy, with resultant low installation costs.

A letter or phone call will bring you Bulletin MSP-124 A. Or if you have a specific dust collection problem, a Hagan engineer will be glad to work with you in developing an economical solution.

HAGAN CHEMICALS & CONTROLS, INC.

HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY, HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO



Dependable LOW COST Power PACKAGE FOR THE SMALL PLANT

This pair of 200 KW Murray Turbine generators supply constant, around-the-clock electrical power in a mid-western plant.

The Murray Design 75 — 400 KW Turbine generator sets provide all the safety and economy features of the most modern larger designs — and at the same time offer the advantage of low initial cost and maintenance.

Murray Turbine generator sets can also be furnished in ratings from 500 KW to 3,000 KW. Your Murray Representative will give you details. Write for his name today.

Murray TURBINES

MURRAY IRON WORKS COMPANY • BURLINGTON, IOWA

Builders of Steam Power Equipment for Nearly a Century

Here's Why...

Silicone Insulated Drive Motors Give Reliability At Lowest Cost

When reliability is a must . . . when essential auxiliaries have to keep going twenty-four hours a day, year in and year out despite temporary overloads and high ambients . . . that's when it pays to have drive motors that are insulated with heat-stable Dow Corning Silicones.

Utility engineers report that silicone insulated auxiliary drive motors carry 30% to 50% overloads without "strain or pain". That's because the thermal stability of Dow Corning Silicones means greater service factor than is possible with any other insulation.

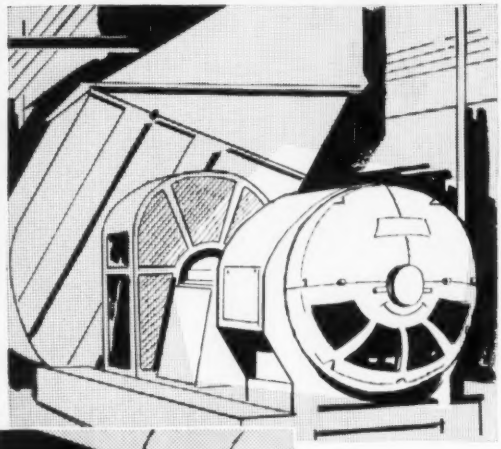
And silicone insulated motors operate at lowest cost because motor horsepower can be matched to normal load. When operating at full load efficiency, there's still plenty of reserve for overloads. You save money on power costs and maintenance, too.

What's more, silicone-insulated motors survive other power plant hazards, such as water, steam, dust, fly ash, cinders and similar motor-killing contaminants.

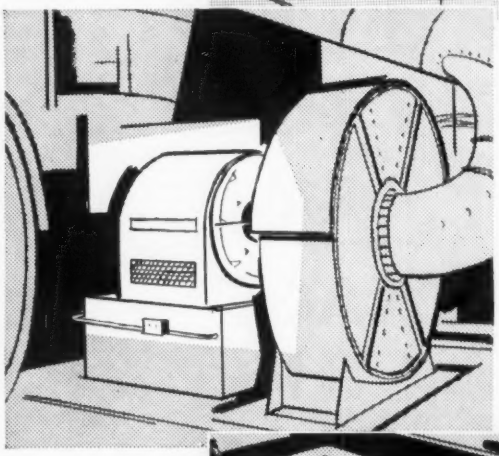
Most leading manufacturers now offer silicone-insulated motors in a wide range of sizes for power plant service. **Reliability costs less with silicones.** That's why it always pays to . . .

Specify DOW CORNING SILICONES and *Save*

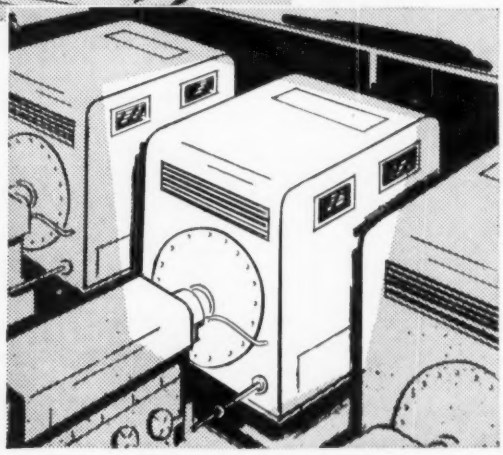
Write Dept. 695 for list of builders who offer Dow Corning silicone-insulated motors.



High ambients and temporary overloads are taken in stride by silicone insulated induced draft fan motors



Coal pulverizers and other essential auxiliaries operate more efficiently with silicone insulated motors matched to normal load



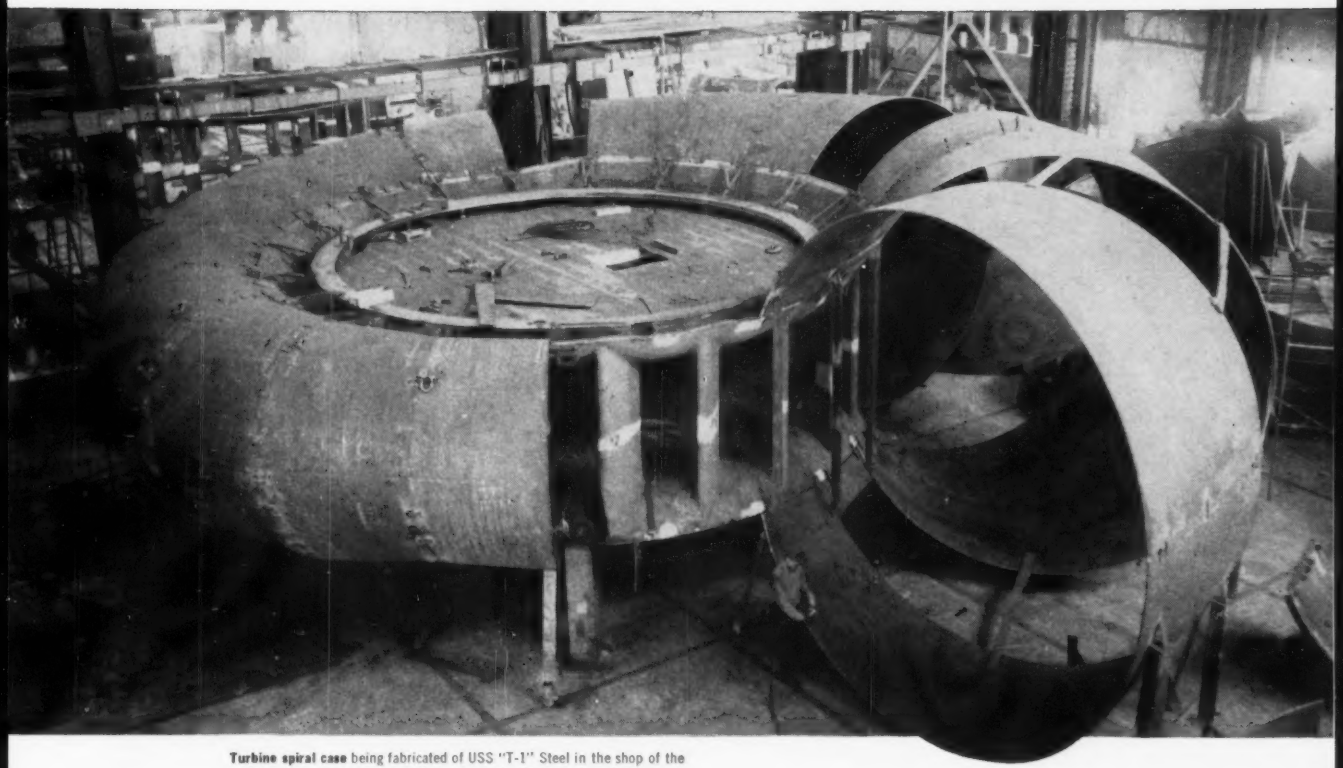
Self-protecting silicone rubber insulation in these boiler feed pump motors defies heat and moisture

first in silicones

Dow Corning CORPORATION

MIDLAND, MICHIGAN

ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS
DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D. C.



Turbine spiral case being fabricated of USS "T-1" Steel in the shop of the S. Morgan Smith Co., York, Pa. Plates ranged in thickness from ½" to 1⅛".

Taming the mighty Snake River with turbine spiral cases of USS "T-1" Steel

Stronger steel reduces weight . . . cuts costs

Four of these huge spiral cases are being built for the Idaho Power Company for use in the Brownlee Dam on the Snake River near Robinette, Oregon. They are designed for a 250-foot head of water. The inlet is 18 feet in diameter and each turbine will generate 144,000 horsepower at a speed of 128.6 rpm. Water will flow through the cases at a rate of 5,460 cubic feet per second.

Because of the fierce pressure, it was obvious that a strong steel was required. USS "T-1"* Steel was selected because it has a minimum yield strength of 90,000 psi. What's more, it can be fabricated, is readily weldable and has high resistance to impact abrasion.

Cost savings. By using USS* "T-1" Steel, there will be substantially less shipping weight across the country and less weld time and weld metal, both in the shop and on the job site. Had carbon steel been specified, double thicknesses would have been required.

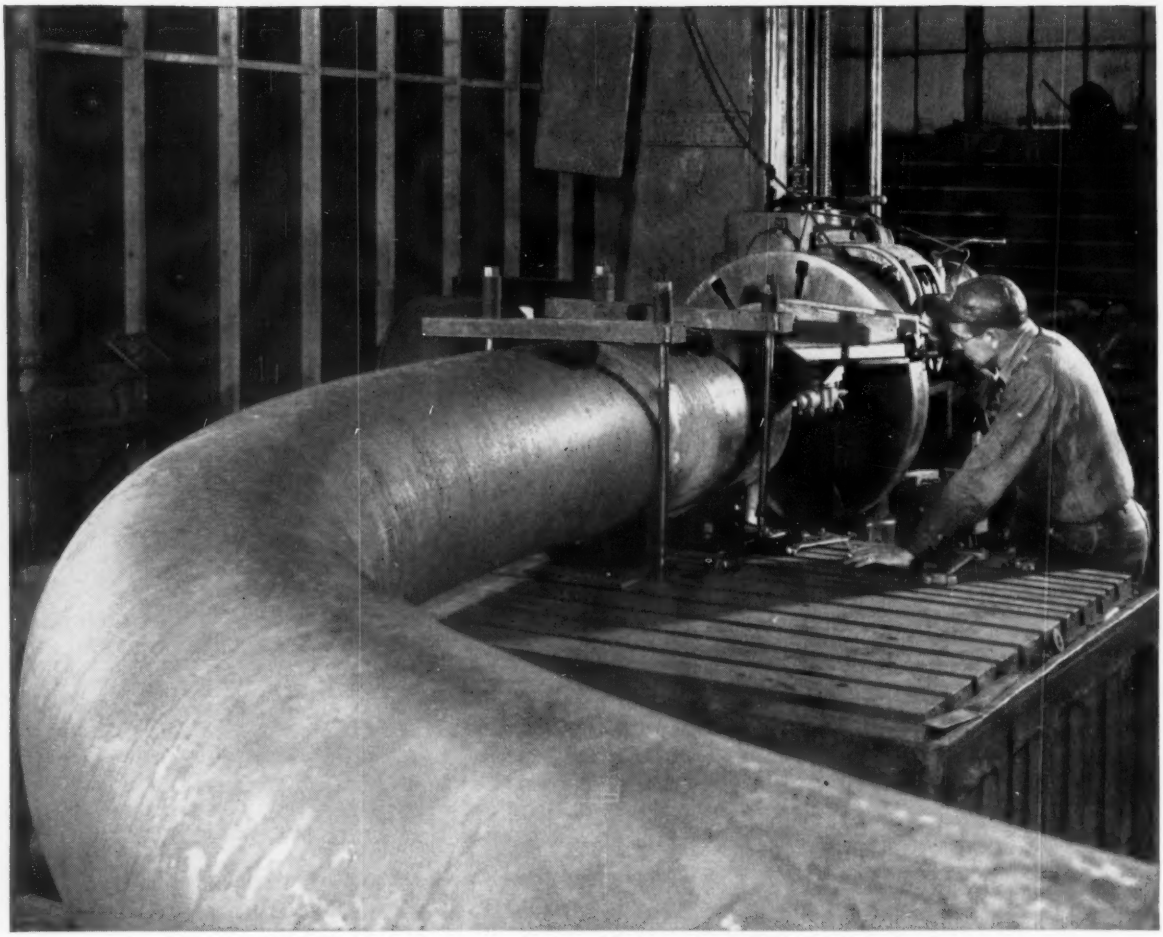
Fabricating operations. Projection of the dimensional outline on the plates was done with Lumitrace. Plates were cut to size by flame-cutting and rolled cold to shape. Some parts were finish welded, others were tack welded and assembled. The spiral case was then disassembled and shipped. Finish welding of segments is to be done at the dam site.

This job points up the economies possible with the use of USS "T-1" Steel. Why not use it for your own equipment? Write for our "T-1" book containing complete information. United States Steel Corporation, Room 2801, 525 William Penn Place, Pittsburgh 30, Pa.

Remember that we also make USS COR-TEN*, USS TRI-TEN* and USS MAN-TEN* Steels . . . widely used in power generation equipment.

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Warehouse Distributors
United States Steel Export Company

USS United States Steel
*TRADEMARK



Boring mill cutting bevel on 18" diameter pipe with 3¼" wall in preparation for welding.

QUALITY CONTROL— key to superior performance

Dravo's Pipe Fabrication shops at Marietta, Ohio, are staffed by highly skilled men who have at their command the very latest in fabricating equipment, including a variety of devices for Quality Control checks. However, at Dravo, Quality Control goes beyond routine checks for compliance with applicable codes. Every step in the fabrication of piping is performed in accordance with procedures developed during Dravo's many years of experience, and is subject to rigid inspection.

Here are some of the Quality Control checks which assure dependable performance in Dravo piping.

1. Radiographic examination of weld. Heavy walled piping may be subjected to several such checks during welding.
2. Heat treatment for stress relieving or normalizing under controlled furnace conditions.
3. Careful preparation of weld area. Dye-penetrant test may be used to assure sound metal at the weld area.
4. Dye-penetrant or magnaflux inspection where indicated.

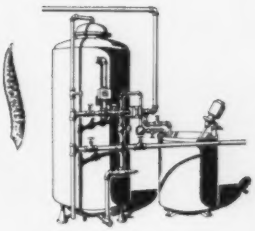
Dravo has the facilities for the fabrication of all kinds of piping. But whether routine or out of the ordinary, every job is held to Dravo standards. A Dravo Piping engineer will be glad to work with you on your next piping job. Write Dravo Corporation, Pittsburgh 22, Pennsylvania.

DRAVO

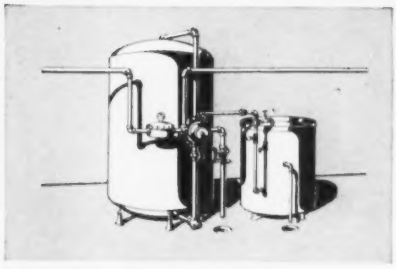
CORPORATION

Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation

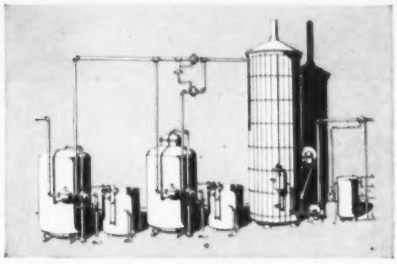
From Potato Peels to Deionization



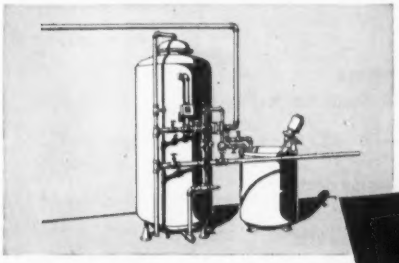
ELGIN SOFTENER CORPORATION 50th Anniversary 1958 WATER CONDITIONING



SOFTENING BY ION EXCHANGE — used to eliminate calcium and magnesium hardness from water. All types of ion exchangers available to meet specific conditions.



DEALKALIZATION BY ION EXCHANGE — produces soft water of controlled alkalinity. Various exchangers used, depending on requirements.



DEIONIZATION BY ION EXCHANGE — produces water of better than distilled quality. Ion exchangers of mixed-bed or multi-column design give "tailor-made" effluent to meet process or boiler plant requirements.

That's the story of Elgin and Water Conditioning Progress during the past 50 years. Compared to water conditioning, few if any fields of human endeavor ever started in greater confusion . . . ever underwent more feverish development . . . ever achieved so many hard-won and revolutionary goals. We ought to know; we stepped into this field at the turn of the century when the only thing the power plant man was sure of was that something drastic had to be done about boiler water. Old-timers may recall they were so desperate in those days that they often used potato peels to cure their boiler water ills. (The tannin and starch they contained may have helped.)

No more effective than home-grown remedies like potato peelings were the early sins committed under the name of "compounds" . . . but soon, thanks to the tireless efforts of the engineer and the chemist, came the enlightenment that was to lead into the revolutionary developments of today.

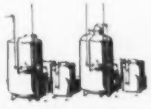
Elgin was a pioneer and leader in this development. Think back over the dazzling progress in ion exchange: Once a cu. ft. of "greensand" would soften only 280 gallons of 10-grain water. Today, working with modern Elgin equipment and resinous ion-exchange zeolites we have stepped this 280 gallons up to 3000 gallons! Yes, and the new Elgin Deionization systems provide water actually more mineral-free than distilled water . . . at a small fraction of the cost of distillation. Pictured at the left are typical examples of ways in which Elgin has kept abreast and ahead of the new demands of modern power and processing plants.

No one knows what the future holds in this or any other field, but it can be uncontrovertibly said that insofar as water conditioning is concerned, you need not worry about the future. This very day we can *make over* any water into exactly the kind and quality you need for *any* use. Why not let us put our experience to work for you.

ELGIN
WATER CONDITIONING
SINCE 1908

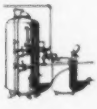
ELGIN SOFTENER CORPORATION
130 N. Grove Avenue, Elgin, Illinois
Representatives in Principal Cities
In Canada: G. F. Sterne & Son Ltd., Brantford

SOFTENERS



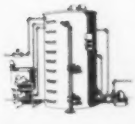
ION EXCHANGERS

FILTERS



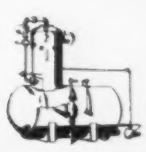
DEIONIZERS

DEALKALIZERS



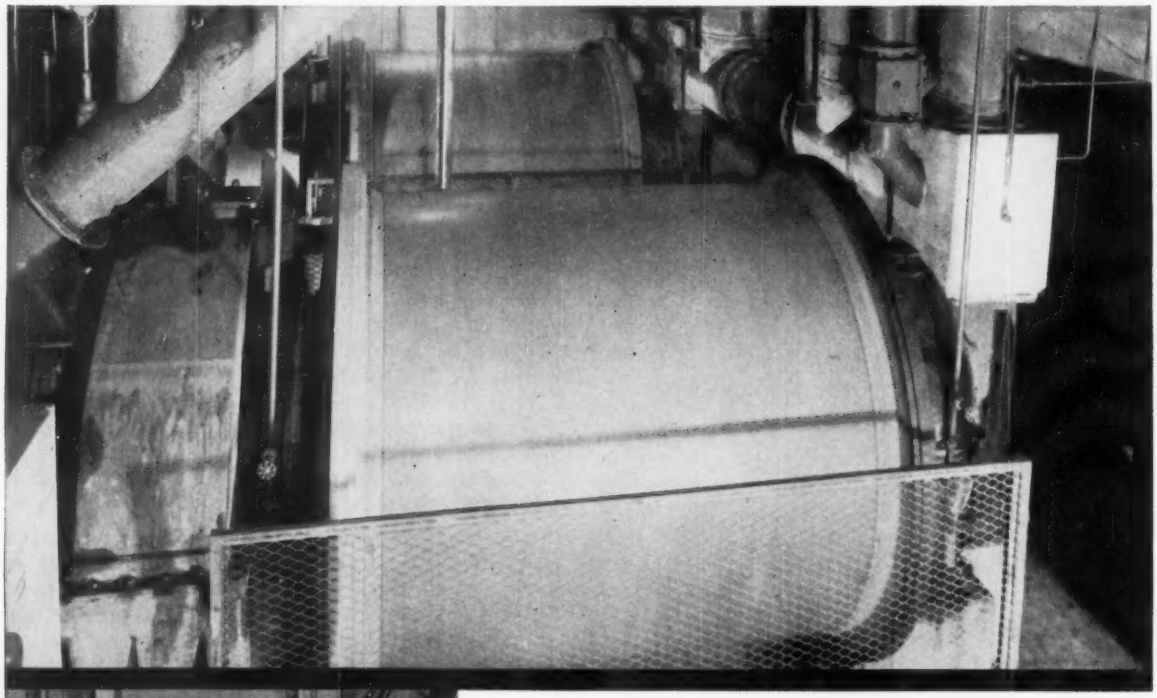
CLARIFIERS

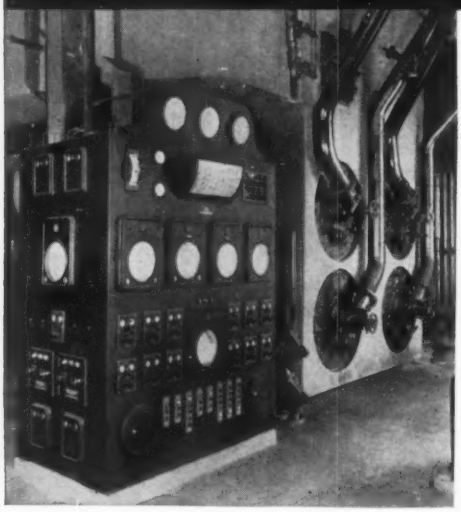
DEGASITORS



DEAERATING HEATERS

KENNEDY Pulverized Coal Firing System





. . . For Economy!

Shelby, Ohio—Municipal Light Department selects KENNEDY Pulverized Coal Firing System for 90,000 lb./hour steam plant generating 475 psig steam.

Shelby chose pulverized coal because of the availability of low cost coal, improved combustion efficiencies and lower stack losses, and because of its instant response to demand changes.

Shelby chose KENNEDY because no other pulverized coal firing system includes these desirable features:

- Fully air swept
- Coal pulverized to superfineness
- Coal completely carbureted, ready for combustion
- Big trunnions for air sweeping
- Balls added without shutting down
- Low operating and maintenance costs
- 85 to 90% through 200 mesh
- 20% moisture removed while pulverizing
- Pulverizes any coal—bituminous, anthracite or coke
- Tramp iron aids in pulverizing
- Reserves of fuel for fast response to demand

Consult KENNEDY before you specify your next firing system.

KENNEDY VAN SAUN
MANUFACTURING & ENGINEERING CORPORATION
405 PARK AVENUE, NEW YORK 22, N. Y. • FACTORY: DANVILLE, PA.

need

steam traps?

name the way you want them!

TYPE A

TYPE D

TYPE C

Nicholson can supply your steam traps, exactly as you want them . . . for any service, any condition. Name the size, material, pressure, capacity you need. Types A, D, C are the ones you'll most likely use. Make your selection.

Sizes: A—from $\frac{1}{4}$″ to 1″. D—from $\frac{1}{4}$″ to $\frac{3}{4}$″. C—from $\frac{1}{2}$″ to 2″.

Materials: Cast Iron, Cast Steel and Bronze.

Pressures: A and D—Vacuum to 200 lbs. C—Vacuum to 300 lbs.

Capacities: From two to six times greater orifice area and capacity than other traps of comparable size.

Why wonder about your steam traps . . . when you can get Nicholsons exactly as you need them for your own applications. Nicholson traps are simple in design, have only one moving part . . . a valve that discharges condensate and prevents steam loss.

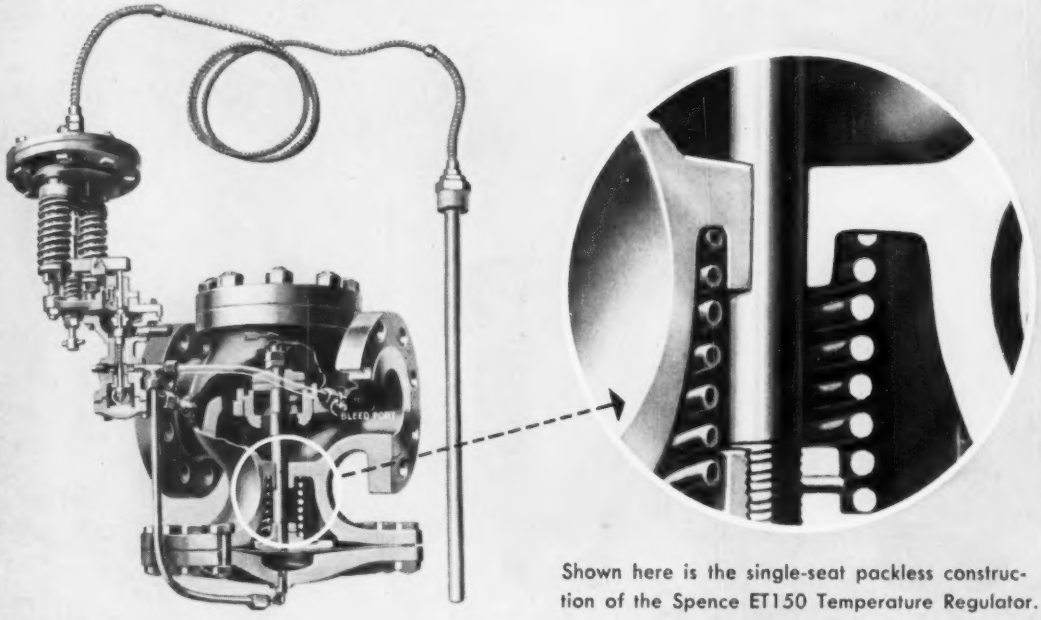
You get faster warmup, with high air-venting capacity. You eliminate costly leakage, with a powerful shut-tight valve action. You get a trap that's service-tested, when you specify Nicholson. You can try one . . . without obligation! W. H. Nicholson and Company, 12 Oregon St., Wilkes-Barre, Pa. Sales and engineering offices in 98 principal cities.

NICHOLSON

of Wilkes-Barre

VALVE TIPS:

Advantages of Packless Construction in Temperature Regulating Valves



Shown here is the single-seat packless construction of the Spence ET150 Temperature Regulator.

One of the biggest headaches in regulating valve maintenance is repacking stuffing boxes.

How often a valve needs repacking, how much time it takes, and the cost of the system downtime all vary with the construction of the regulator and the service it's used for. No matter how you calculate all these variables it's still a headache—and an expensive one.

In the temperature regulator shown above (Spence Type ET150) stuffing boxes are eliminated. This is done by what is known as "balanced" diaphragm construction. You can see in the cutaway drawing that pressure is applied to both sides of the large metal diaphragm. The upper side is exposed to delivery steam pressure and the lower side is exposed to loading pressure applied by the pilot. When the pilot closes, both delivery pressure and loading pressure are equalized through the bleedport and connecting tubing.

This construction not only does away with repacking problems, but it makes possible additional savings as well. For example, you will note in the sectional blow-up that this design eliminates a closely fitted stem and guide. Dirt or other foreign matter doesn't have much of a chance to lodge between these parts and cause sticking.

Another cause of binding or sticking, uneven expansion of closely fitted parts, is also eliminated with this design. In addition, valve stem wear is reduced for the same reason.

Lower maintenance is not the only advantage of this packless construction. Accuracy of regulation is also improved because friction due to a stuffing box, dirt, or uneven expansion is not a problem. The large, *balanced* metal diaphragm is more sensitive to slight changes in pressure.

Guaranteed Not To Wiredraw

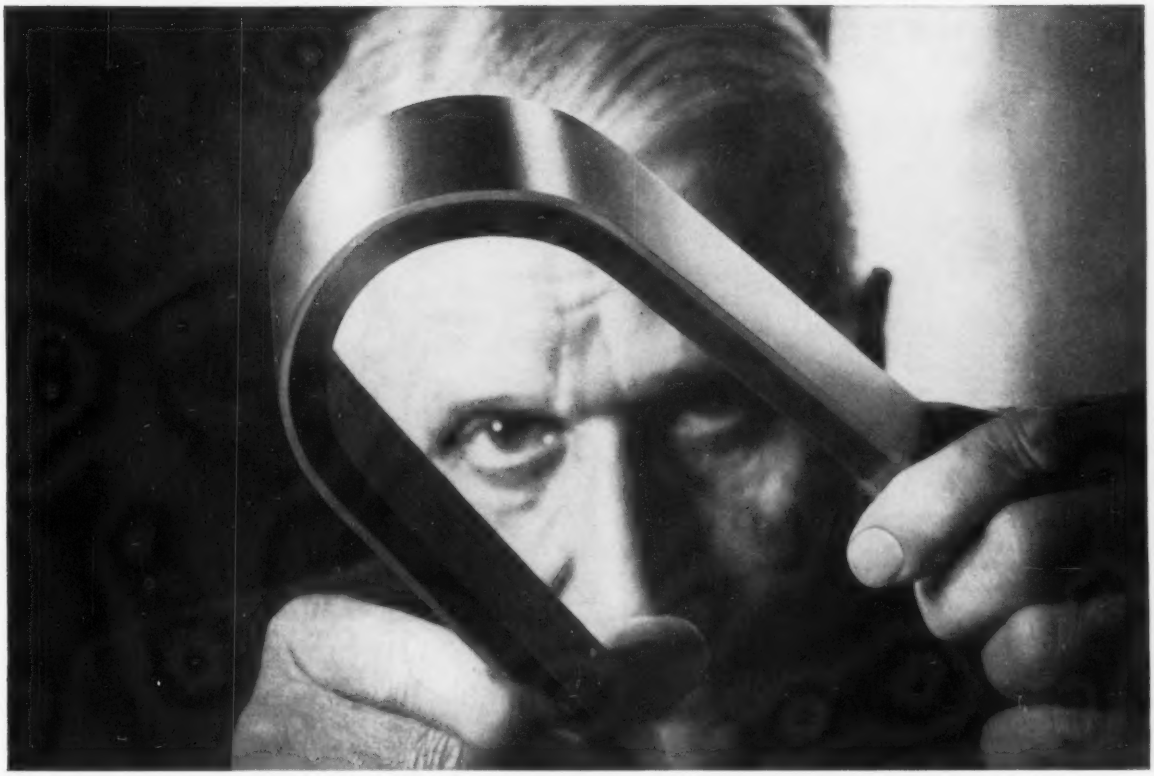
If seats and discs are cut by steam (wiredrawn) the loss of steam through these grooves can be another expensive item — directly charged against the regulating valve. Fortunately, you can eliminate these costly leaks by specifying a temperature regulator that is *guaranteed not to wiredraw.*

Spence makes such a guarantee because their seats and discs are made of SECO Metal. Over 20 years experience with this special alloy has failed to produce a single case where a SECO Metal seat or disc had been cut by steam. All that's required is an approved strainer located ahead of the regulating valve. Expensive steam leaks just can't happen with this combination of SECO Metal and single-seat design.

If you would like to have more information on Spence Temperature Regulators, drop us a line and ask for Bulletin T150. It gives more detailed information on these and other Spence design features. Piping layouts and helpful information on the installation of temperature regulators are also included. Write for your copy today.

SPENCE ENGINEERING COMPANY, INC.
Walden, New York
SE 148

FOR COAL BUNKER NOSES,
CHUTES, HOPPERS, SPREADERS THAT MATCH
THE LIFE OF YOUR BOILER...



Take a comptroller's-eye view of Lukens Clad Steel

■ He sees savings ... and so will you! In bunker noses and other coal handling equipment, Lukens clad steel puts a virtual stop to costly coal hangups and to damage from sulfuric acid in wet coal. Its durability is proved by installations more than 10 years old which show no measurable wear – ample evidence that it will match the life of your boiler.

Further savings accumulate from its ready fabrication, easy modification, and through freedom from down time and maintenance. The reasons:

Helping industry choose steels that fit the job

Lukens clad steel is not a lining but a solid plate – one side corrosion resistant stainless steel permanently joined in a metallurgical bond to a rugged yet economical backing steel.

Lukens will help you and your fabricator select the proper types and gages to fit your needs. *Bulletin 740 will give you performance facts and production information.* Send in the coupon and ask for the names of experienced coal handling equipment builders. Lukens Steel Company, Coatesville, Pennsylvania.

SEND FOR THIS BOOKLET TODAY!

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Manager, Marketing Service
LUKENS STEEL COMPANY
132 Lukens Building, Coatesville, Pa.

Please send me a free copy of your 16-page booklet, "Stainless-Clad Steel for Coal Handling."

NAME _____ TITLE _____

COMPANY _____

STREET ADDRESS _____

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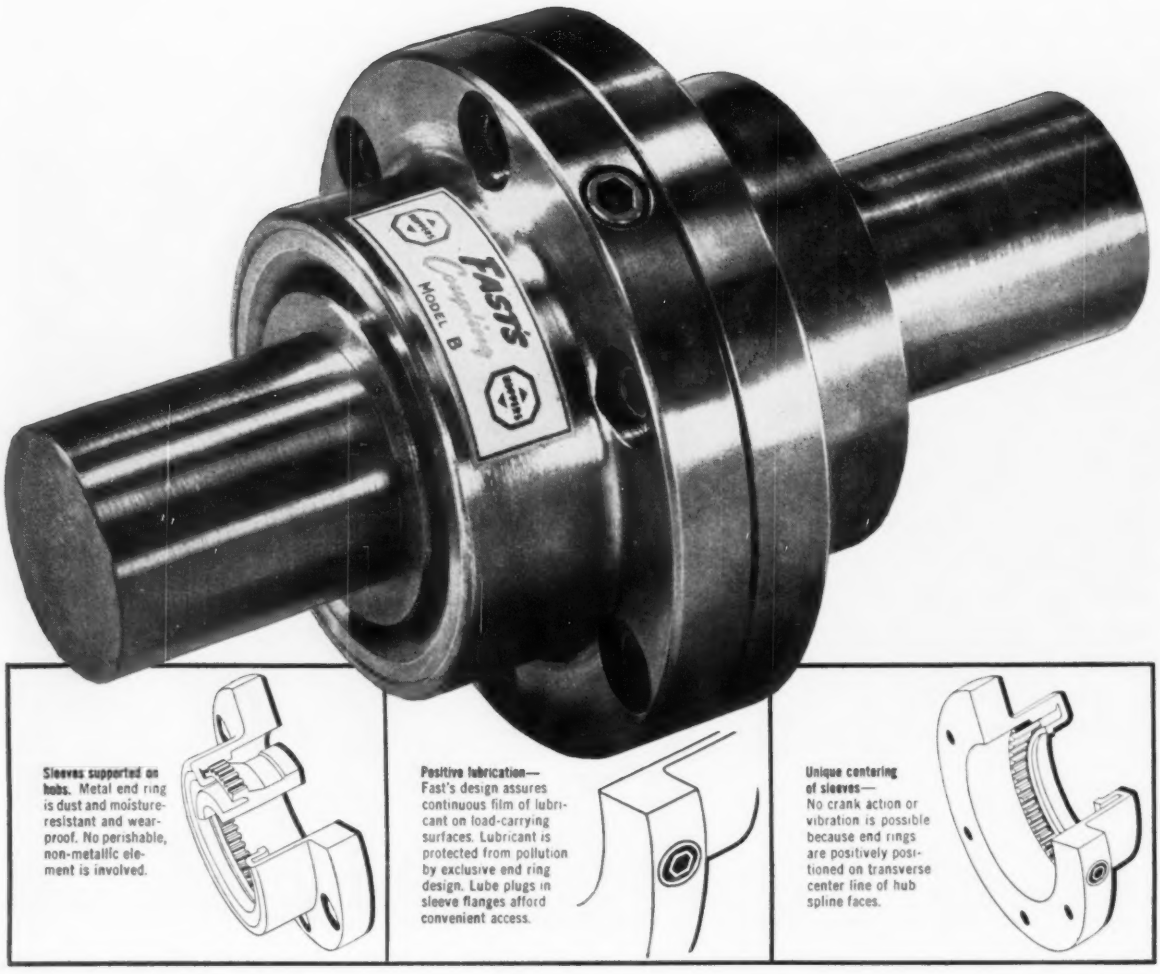


Sleeves supported on hubs. Metal end ring is dust and moisture-resistant and wear-proof. No perishable, non-metallic element is involved.

Positive lubrication— Fast's design assures continuous film of lubricant on load-carrying surfaces. Lubricant is protected from pollution by exclusive end ring design. Lube plugs in sleeve flanges afford convenient access.

Unique centering of sleeves— No crank action or vibration is possible because end rings are positively positioned on transverse center line of hub spline faces.

Fast's Model B coupling reduces downtime and upkeep for light-to-medium drives

Mechanical flexibility eliminates costly shutdowns and expensive shaft replacements. But—it's only one of many cost-saving features.

Now you can profit from the durability and economy of famous Fast's couplings in a smaller and lower-cost version—available in 5 sizes for shafts ½" to 3⅛" in diameter.

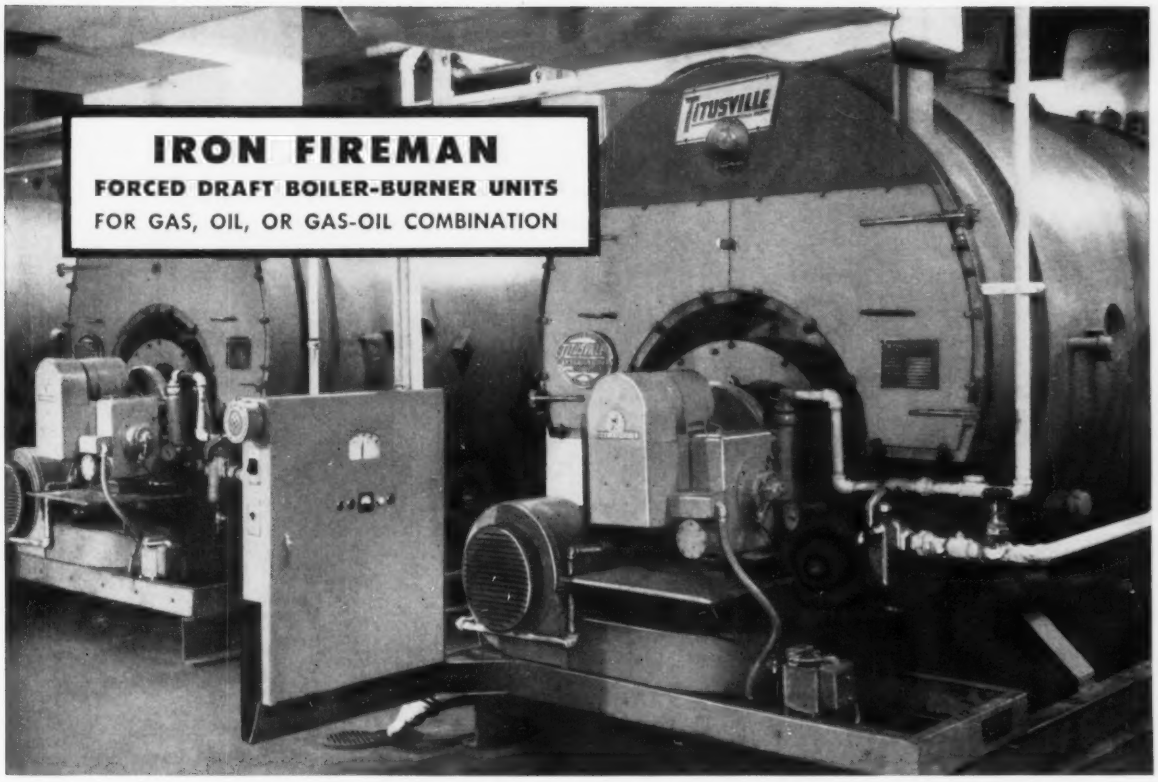
The Model B coupling gives you the same features that have made Fast's the world's leading coupling for over 35 years. You get the same trouble-free performance, longer service life and lower maintenance costs. You also get prompt delivery because stocks are on hand to meet practically every need. Free engineering service is also available.

Write today for more details to KOPPERS COMPANY, INC., Fast's Coupling Dept., 3305 Scott Street, Baltimore 3, Md.

Engineered Products
Sold with *Service*

KOPPERS

THE ORIGINAL
FAST'S Couplings



Shown above are two Iron Fireman RFA-60 burners and Titusville boilers in operation at the New York Telephone Company, New York, N. Y. Burners are forced draft for firing oil. Mr. Edward L. McHugh, Building Maintenance Supervisor of the New York Telephone Company states, "Dependable, uninterrupted service and minimum maintenance has characterized the operation of these burners." Architect: Vorhees, Walker, Smith and Smith, New York; Consulting Engineer: Syska & Hennessey, New York; Heating Contractor: Jarcho Bros., Long Island, N. Y.

Iron Fireman Boiler-Burner Units Offer You These Advantages

Easy to size and specify. After deciding on the fuel (gas, oil or gas-oil dual fuel) and determining the required load, it is only necessary to refer to a simple chart to find the correct size of boiler-burner unit for your job.

No high stacks — no high ceilings. Forced draft eliminates costly and unsightly stacks. Compact boiler requires little headroom.

Low installation cost. Installation costs are low. No special boiler setting; no intricate wiring (factory wired and tested control panel is part of the unit); no complicated piping; no on-the-job refractory work. Factory engineering throughout assures exceptional fuel economy. Models for any type of high or low pressure gas, or any grade of oil from No. 2 to low cost No. 6.

Separate firing units available for all types of boilers. The Iron Fireman forced draft burner is a complete firing system which requires little, if any, firebox alteration, no pit for underfloor air, no ignition arch. Easily applied to new or existing boiler settings.

Send for catalog with complete specifications

IRON FIREMAN.

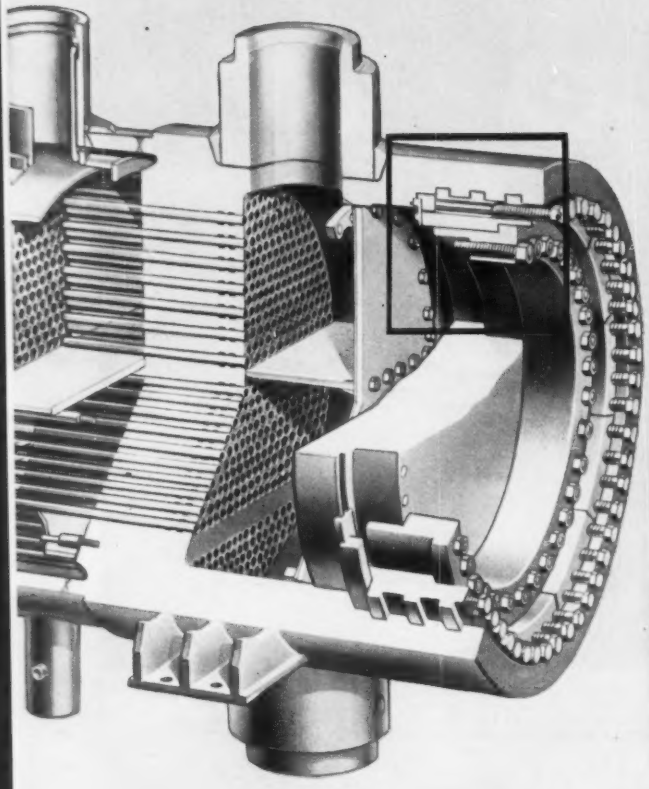
AUTOMATIC FIRING EQUIPMENT
FOR OIL, GAS, COAL

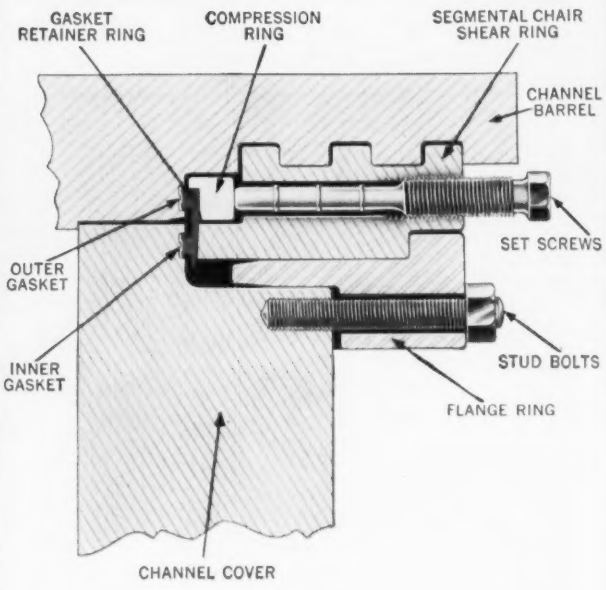
IRON FIREMAN MANUFACTURING COMPANY
3037 West 106th Street, Cleveland 11, Ohio.
(In Canada, 80 Ward Street, Toronto, Ontario.)

Please send information on following equipment:
- ☐ Complete boiler-burner units.
- ☐ Forced draft firing units.

Name_____
Firm_____
Address_____
City_____ Zone____ State_____

ALCO FEEDWATER HEATERS





Detail of Type "D" closure on ALCO high-pressure feedwater heater shows simplicity of dismounting and reassembly, isolation from contained condensate.

TWO MILLION HOURS OF OPERATION PROVE ALCO'S TROUBLE-FREE CLOSURE

The ALCO Type "D" closure, standard on all ALCO high-pressure feedwater heaters, has now rolled up more than two million hours of operation in power plants. During this time, the positive mechanical-locking design of the closure has turned in an outstanding record of trouble-free performance.

In addition, the ALCO Type "D" closure provides many other important operational advantages. The closure's locking strength is uniform. Screwed fastenings and locking devices are dry and cannot be corroded by condensate. If maintenance of tubes is necessary, the closure is easily demounted with hand tools for full access to tube ends. Reassembly is quickly accomplished with the same hand tools. For added savings, no costly and time-consuming pressure welding is necessary.

Specialists in any ALCO sales office will be happy to discuss with you in detail the design, construction and many advantages of the ALCO Type "D" closure on feedwater heaters. For an informative brochure, write ALCO Products, Inc., Dept. 135, Schenectady 5, New York.

ALCO

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NEW YORK

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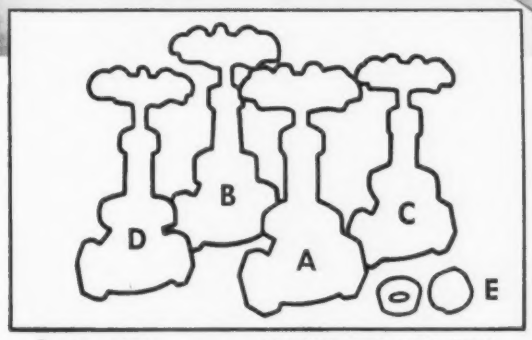
Locomotives · Diesel Engines · Nuclear Reactors · Heat Exchangers · Springs · Steel Pipe · Forgings · Weldments · Oil-Field Equipment



A — No. 225P.....350 WSP 550F, 1000 WOG
B — No. 260P.....300 WSP 550F, 600 WOG
C — No. 245P.....200 WSP 550F, 400 WOG
D — No. 237P.....150 WSP 500F, 300 WOG
E — "500 Brinell" Stainless Steel Plug Type Seat and Disc

Walworth offers four lines of Bronze Globe Valves with stainless steel, plug-type seats and discs. Advantages of these valves include:

- **Stainless Steel Plug-Type Seats and Discs,** heat-treated to a minimum of 500 Brinell hardness reduces wire-drawing to a minimum. Seats and Discs are machined and fitted simultaneously, assuring perfect mating.
- **Deep Stuffing Boxes with Glands** are fitted with reinforced, molded packing. Valves can be repacked under pressure when fully opened.

For Longer Bronze Valve Life . . .

"500 BRINELL" PLUG-TYPE STAINLESS STEEL SEATS AND DISCS

150 lb. 200 lb. 300 lb. 350 lb.

- **Oversize Stems,** made of high tensile strength silicon-bronze, assure long life.
- **Rugged Body Hexes,** are flat on top; do not interfere with wrench gripping body-to-bonnet union ring connection.
- **Bodies,** made of Composition M bronze (ASTM B61), have ample wall thickness to provide high safety factor.
- **Patented Handwheels** are air-cooled and designed with a "finger-fit grip." Makes turning easy even when wearing greasy gloves.
- **Identification Plates** secured by lock-washer under stem nut, show Figure Number of valves and make re-ordering sure and easy.

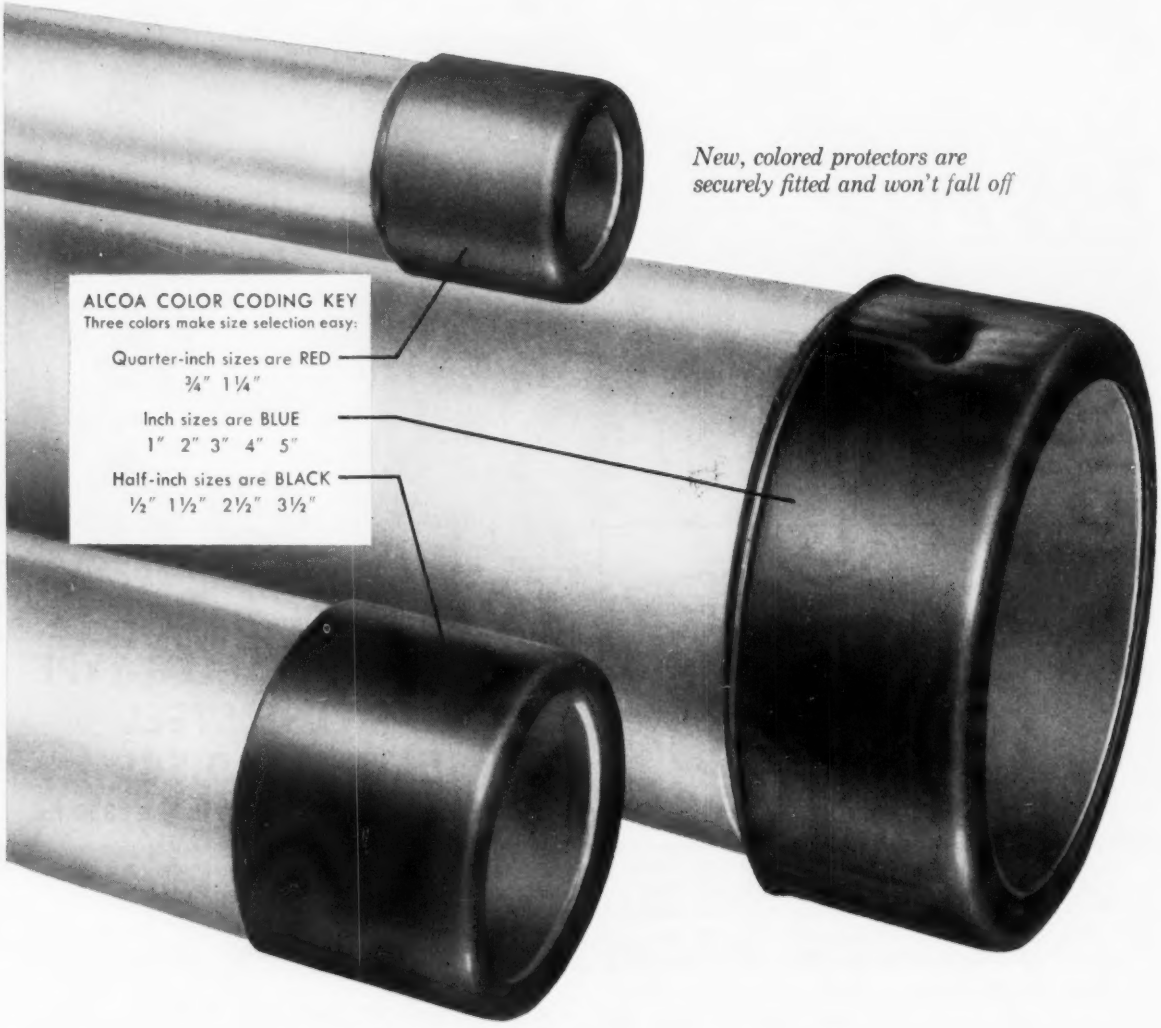
FOR COMPLETE INFORMATION, *SEE YOUR WALWORTH DISTRIBUTOR OR WRITE FOR ILLUSTRATED CIRCULAR*

WALWORTH

750 Third Avenue, New York 17, New York

SUBSIDIARIES: ALOYCO ALLOY STEEL PRODUCTS CO. CONOFLOW CORPORATION GROVE VALVE & REGULATOR CO. SW SOUTHWEST FABRICATING & WELDING CO., INC. MH M & H VALVE & FITTINGS CO. WALWORTH COMPANY OF CANADA, LTD.

NOW! COLOR CODING ON ALCOA RIGID CONDUIT SIMPLIFIES SIZE SELECTION AND STOCKING


ALCOA COLOR CODING KEY
Three colors make size selection easy:
Quarter-inch sizes are RED
¾" 1¼"
Inch sizes are BLUE
1" 2" 3" 4" 5"
Half-inch sizes are BLACK
½" 1½" 2½" 3½"

New, colored protectors are securely fitted and won't fall off

Thread protectors on Alcoa® Aluminum Electrical Rigid Conduit are brightly colored to help you tell size at a glance.

These all-new thread protectors are made to stand up under rough handling in the warehouse or on the job. They spell an end to guesswork and time-consuming mistakes in conduit selection.

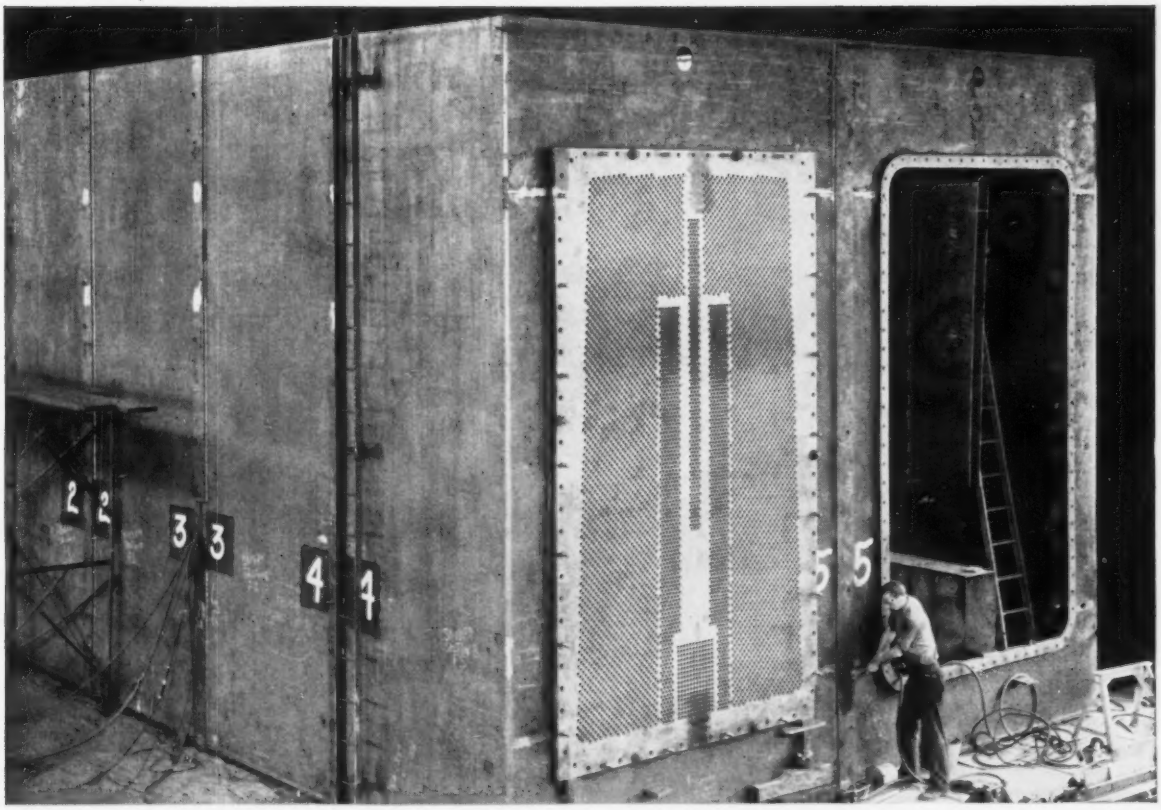
With new low prices, Alcoa Aluminum Rigid Conduit is today's most economical buy. Its light weight reduces installation costs. It is nonsparking and nonmagnetic. Excellent corrosion resistance eliminates painting, reduces maintenance and extends life. Find out why Alcoa Aluminum is *your* best conduit buy. Contact your Alcoa Conduit distributor or write Aluminum Company of America, 2322-E Alcoa Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM CONDUIT
ALUMINUM COMPANY OF AMERICA

Underwriters' Laboratories, Inc. INSPECTED
RIGID CONDUIT
ISSUE MU-28

Your Guide to the Best in Aluminum Value

"ALCOA THEATRE"
Exciting Adventure
ALTERNATE MONDAY EVENINGS

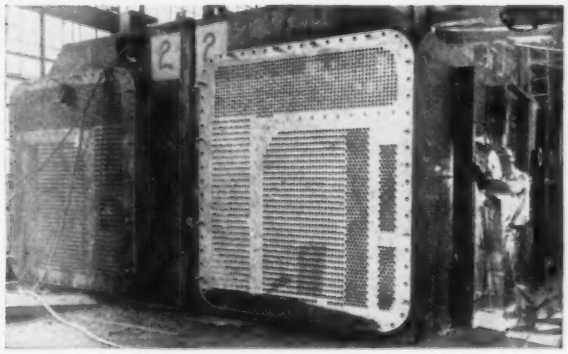


HERE'S ONE SHELL of this twin-shell, triple-lane unit just before shipment to Consolidated Edison's Astoria Station. It's designed to condense 1,600,000 lbs. steam/hr. at 1.87" Hg., with 244,000 gpm circulating water, and has 27,450 aluminum-brass tubes. Unit serves 335,000 kw turbine.

HUGE, SINGLE-PASS, 187,000 sq. ft. CONDENSER

. . . designed and built by C. H. Wheeler is now being installed at world's largest metropolitan utility

VICE-PRESIDENTS LEE YETTER and Roy Droescher, and Chief Engineer Paul Hamm are responsible for the design and construction of all Wheeler condensers. They work with engineers employed by C. H. Wheeler's customers, with turbine manufacturers' engineers and consulting engineers in BTU chasing.



TYPICAL REVERSE FLOW CONDENSER is this 35,000 sq. ft. unit for a Southern electric utility. Patented Reverse Flow feature permits flushing debris from tubes with only slight (and momentary) vacuum loss. Note low height to save head room, rectangular cross section to further utilize space for this Wheeler client.

C. H. Wheeler Mfg. Co.

19TH & LEHIGH AVENUE
PHILADELPHIA 32, PA.

Steam Condensers • Vacuum Equipment • Centrifugal, Axial & Mixed Flow Pumps • Marine Auxiliary Machinery • Nuclear Products

Air-conditioning the ultramodern

Bank of the Southwest

Architect: KENNETH FRANZHEIM, HOUSTON, TEXAS
Consulting Engineer: H. E. BOVAY, JR.
General Contractor: W. S. BELLOWS CONSTRUCTION CO., HOUSTON, TEXAS
Mechanical Contractors: BARBER, INC., and STRAUS-FRANK CO., HOUSTON, TEXAS

In Houston, Texas, covering a solid city block, is one of the most architecturally sophisticated banks in the Southwest. Its four-story base, sheathed in red granite, encloses a spacious bank and a panorama of shopping arcades. Topping the base is a gleaming tower of business offices.

Completely air-conditioned, the new Bank of the Southwest building employs over 150 tons of USS NATIONAL Seamless Steel Pipe in its vast system. Sizes range from 2 inches in diameter through 20 inches.

USS NATIONAL Seamless Pipe is consistently the number one choice of engineers and contractors throughout the country for air-conditioning, heating and power installations. Its ability to render efficient, trouble-free service under all types of pressure and temperature conditions has given NATIONAL Seamless a reputation for safety and dependability excelled by no other pipe. For further information or assistance with your pipe problems, get in touch with us.

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United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
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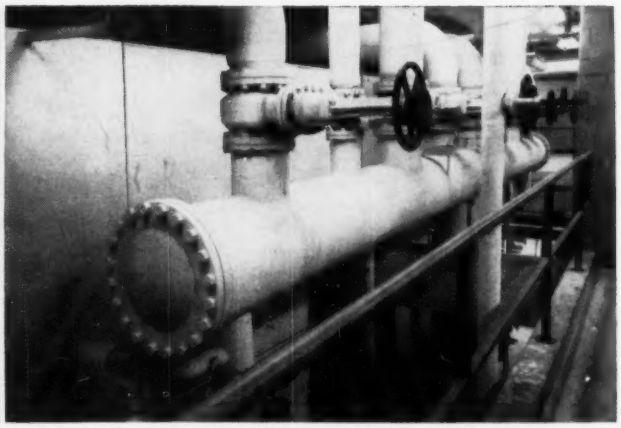
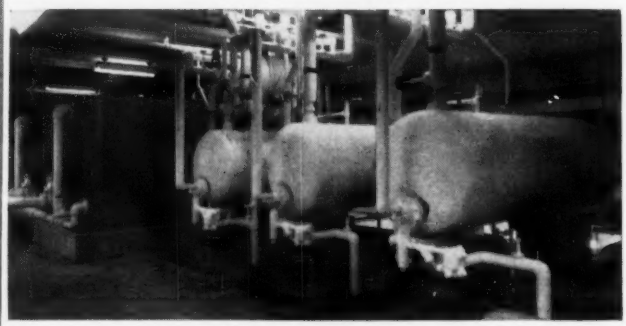
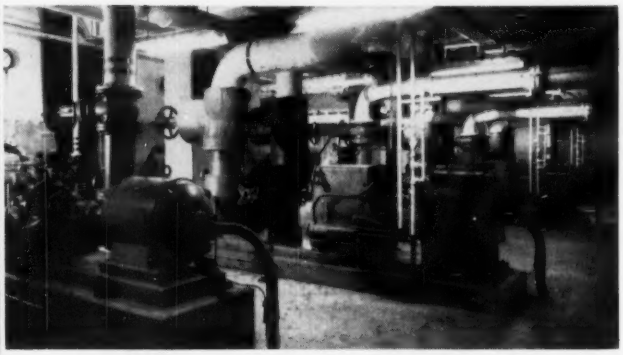


20-inch drop header with 10-inch boiler leads on the steam heater system take-off from the boilers. All NATIONAL Seamless.

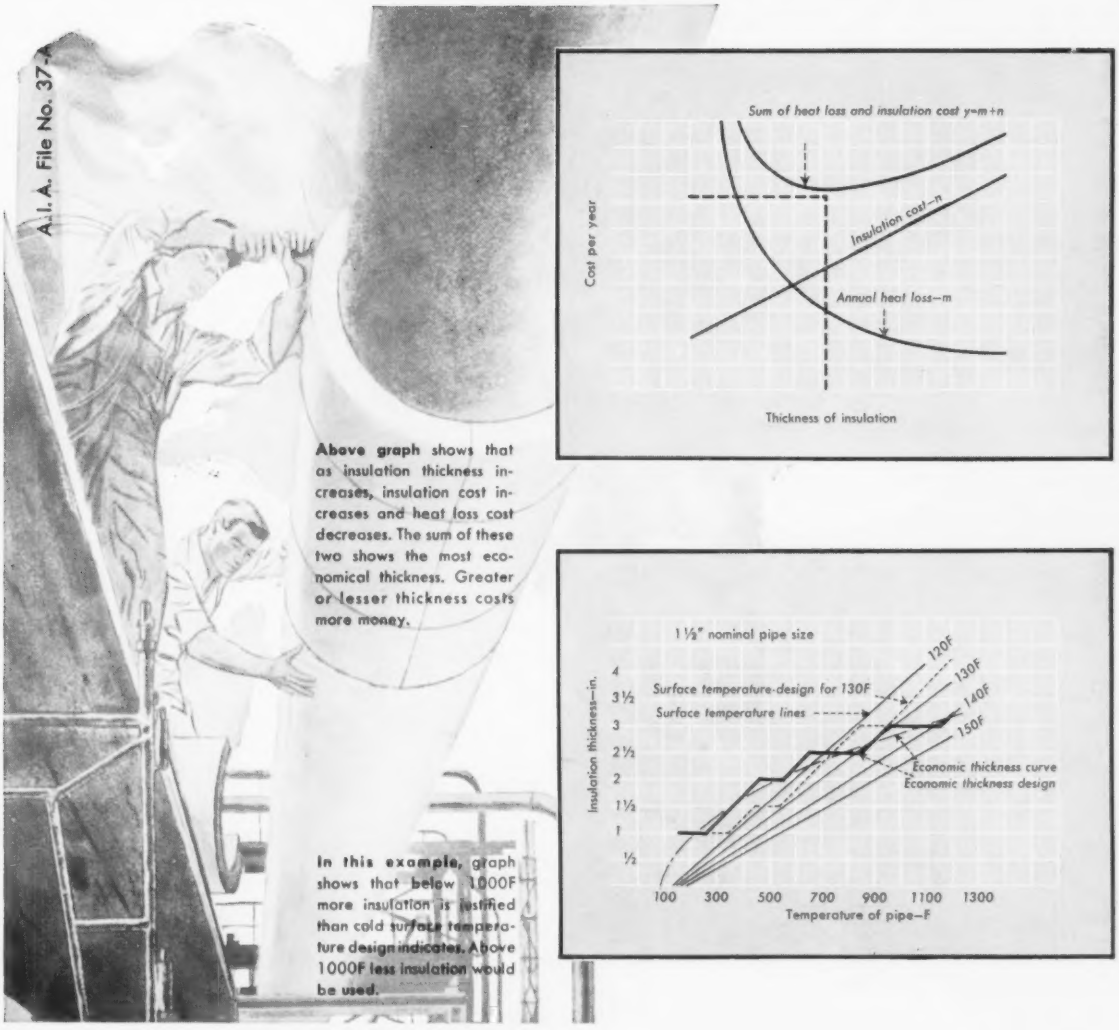


4-inch domestic hot water piping to generators and surge tanks. All NATIONAL Seamless.



12-inch NATIONAL Seamless Pipe from tower to main condenser and chill water pumps and gear boxes.

A.I.A. File No. 37-A



"COLD SURFACE" CRITERION WASTES MONEY!

How J-M engineers determine economic insulation thickness

to give you more for your insulation dollar

OVER-ALL cost of the operation should always be the determining factor in selecting insulation thickness. Yet, millions of dollars have been wasted because of rigid adherence to the cold surface temperature method. When Johns-Manville insulation is applied, J-M engineers carefully determine which thickness will provide the greatest operational savings. And this "economic thickness" is usually more (or less) than the cold surface method indicates.

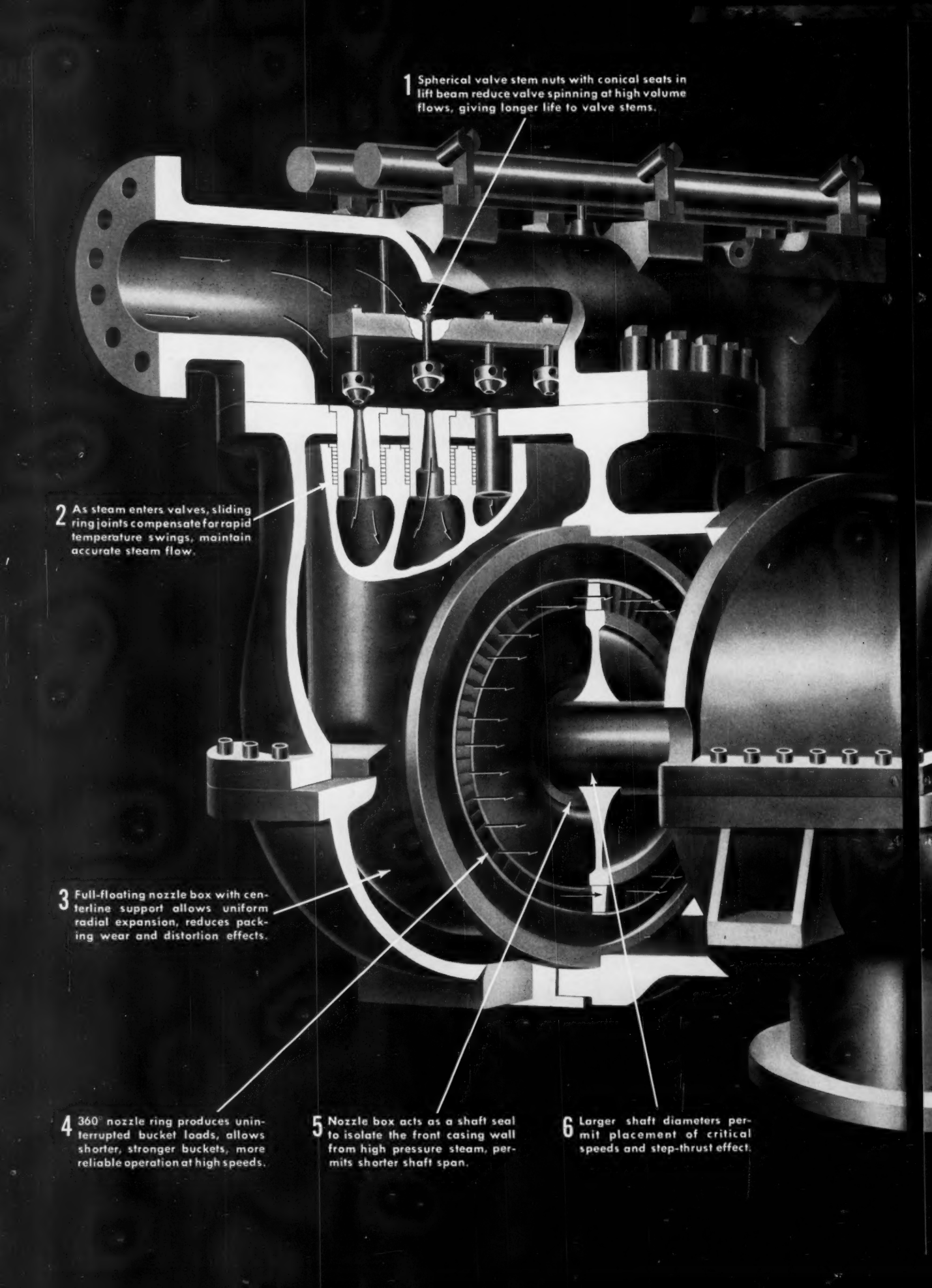
Here's how it works. The annual cost of the heat loss through the insulation is plotted for various thicknesses. Also plotted is the annual cost of insulation. A third curve is then drawn as the sum of heat loss and insulation cost. The economical thickness is found where this third curve reaches its lowest point.

To arrive at the above figures in a given instance requires the following: 1. Cost of heat production per million Btu; 2. Rate of heat loss through insulation in Btu per unit area per hr; 3. Annual hours of operation; 4. Applied cost of insulation per unit area; 5. Rate of amortization and required return on the insulation investment cost. Items 2 and 4 are available from the insulation manufacturer; others are normally supplied by the plant engineer.

For more complete information, call or write Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario. Ask for reprint of technical article "Select Economic Insulation Thickness."

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS


1 Spherical valve stem nuts with conical seats in lift beam reduce valve spinning at high volume flows, giving longer life to valve stems.
2 As steam enters valves, sliding ring joints compensate for rapid temperature swings, maintain accurate steam flow.
3 Full-floating nozzle box with centerline support allows uniform radial expansion, reduces packing wear and distortion effects.
4 360° nozzle ring produces uninterrupted bucket loads, allows shorter, stronger buckets, more reliable operation at high speeds.
5 Nozzle box acts as a shaft seal to isolate the front casing wall from high pressure steam, permits shorter shaft span.
6 Larger shaft diameters permit placement of critical speeds and step-thrust effect.

New full-circle nozzle ring helps give more

PROFITABLE POWER

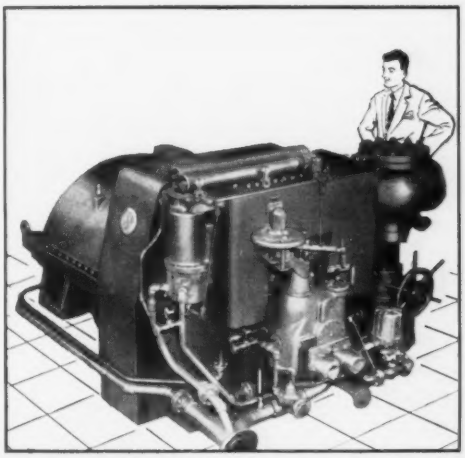
at high ratings, high speeds with General Electric turbines

The new 360° nozzle ring available on General Electric high-volume flow turbines allows horsepower ratings to 15,000 and speeds to 12,500 rpm without appreciable increase in turbine dimensions. Now you can drive high-speed compressors more efficiently with powerful General Electric mechanical drive turbines.

Greater reliability is realized in these G-E high-speed turbines because the unique 360° nozzle ring distributes power to all of the buckets. This reduces bucket loading and increases turbine reliability.

Turbine maintenance is greatly simplified because there are few high-pressure joints and no jumper pipes in this one-piece internal shell.

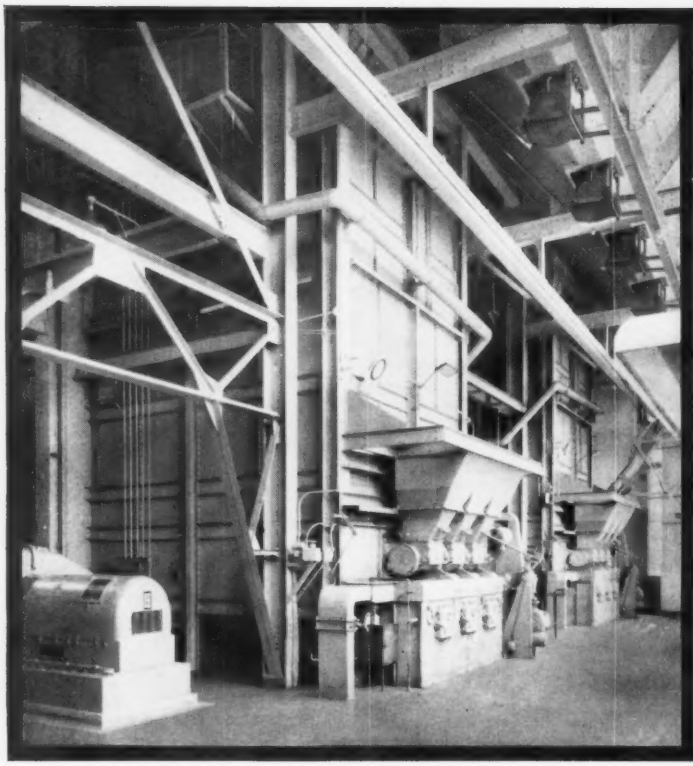
Ask your nearby G-E Apparatus Sales Office for details on how mechanical drive turbines can help bring profitable power to your high-speed applications—or write to General Electric Company, Section 241-11, Schenectady 5, N.Y.

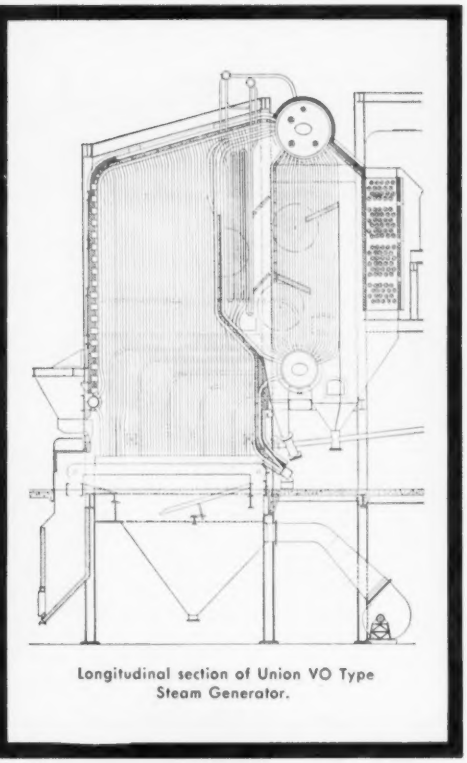


THIS G-E TYPE DRV MULTIVALVE mechanical drive turbine meets stiff process requirements under conditions of frequent load fluctuations, or where there is large volume steam flow.

Progress Is Our Most Important Product

GENERAL ELECTRIC





Longitudinal section of Union VO Type Steam Generator.

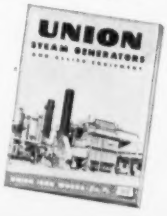
Union Boilers score new high at Notre Dame with 83% efficiency

Spread over a 1700-acre campus near South Bend, the University of Notre Dame is a self-sustaining community of 6,000 students and 500 faculty members.

To meet the demands of increasing enrollments, as well as to handle its own power requirements, the University expanded its steam heating plant and converted it to a steam-electric power plant. Three of the four original boilers were replaced with a pair of Union 2-drum VO Type Steam Generators. Spreader-stoker fired, each unit is equipped with a superheater and an economizer. Normal rating is 70,000 lbs./hr. at 470 psi and 750° F.

Although the heating load is increased 20%, and electric power is now supplied for all 75 buildings on the campus, boiler efficiency has been upped from 68% to more than 83%. *Coal consumption remains unchanged!*

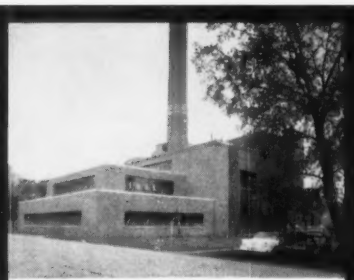
This is just one job report where Union efficiency and dependability have achieved top-notch economy of operation. Across the nation, Union Boilers are giving similar service to industrial, institutional and public power plants, providing day-in and day-out, the best performance value in modern steam generating equipment.



GET FULL DETAILS

Information on the several types of steam generators built by Union is yours for the asking. Write for illustrated Catalog GB-153.

Aerial view of Notre Dame — with 75 buildings on a 1700-acre tract, this campus is a city in itself.



Steam-electric power plant makes campus community independent of outside power sources.

UNION

UNION IRON WORKS

ERIE, PENNSYLVANIA

SURFACE COMBUSTION CO.
builds-in High Thermal Efficiency

and also gets
Easy Installation
by using

BALDWIN-HILL® MONO-BLOCK®

In building high temperature processing equipment like this gas generator, Surface Combustion Co. demands maximum thermal efficiency from insulation along with a minimum of application problems.

B-H MONO-BLOCK fills these requirements, not only through low thermal conductivity over the full temperature range to 1700° F., but by its exceptional ease of handling and installation. In this application, MONO-BLOCK was simply impaled over pre-welded studs and secured by speed clips.

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How Research Shapes Our Future Prosperity

If you are looking for an industry that is going to keep on booming in 1958 and every year for the next decade, here it is. It is the industry of technological innovation through research and development.

Last year this great new industry spent over $7 billion to discover and develop new industrial products, processes and equipment. This year the preliminary McGraw-Hill survey indicates that total expenditures for industrial research and development will be even greater, perhaps as much as $8 billion. Of the companies surveyed, 57% plan to spend as much as in 1957 and 38% plan to spend more.

The sustained expansion in research and development is the best guarantee we have that the current decline in business investment in new plants and equipment will be relatively short-lived. There can be no prolonged decline in investment in an economy where technology is changing rapidly.

This editorial is designed to show how the continued surge in research and development can be expected to lead first to new products, and eventually to renewed expansion of investment in new industrial plants and equipment. Such expansion is the essence of national economic growth.

A Slow Start

The impact of research on sales and investment is still very gradual. Research spending itself has more than doubled in the last four years. But only 32% of all manufacturing firms report significant capital outlays to make new products. We are not reaping the full dividends of industrial research as yet for several reasons:

- Research expenditures were relatively small until the Korean War of 1950 brought substantial government contracts in aviation, electronic and related fields. Heavy research outlays for civilian and industrial products came even later.

- There is an average *lag*, according to research directors consulted by the McGraw-Hill Department of Economics, of roughly seven years from the start of research until the product is ready for large scale output — about five years of research and at least two years to solve production problems and develop markets.

- Complex products, such as new consumer durables and industrial machinery, have an even longer time lag.

However, new developments are certainly underway. Research began to increase in all lines of business when Korean War restrictions and

the excess profits tax came to an end in 1953. The tax revision of 1954 added a new incentive by making research outlays deductible as a current business expense. By 1955, the research boom was on.

When Is The Payoff?

With a lag of about seven years, it will be the early 1960s before these new developments become a dominant factor in capital investment. But once the flow of new products and new processes starts, it will accelerate sharply — just as research spending has accelerated in the past few years.

By 1960, over $50 billion in sales will be coming from products not on the market as recently as 1956. Sales of new products will increase year by year, but they will gain most in 1960-1962, or five years after the recent spurt in research expenditures.

Capital expenditures to manufacture new products will also rise, but with a slightly longer lag. Here the sharpest rise should come in 1962-1965, as the new products reach a volume that calls for a significant amount of new capacity. In most cases, initial output of new products will come from existing capacity.

This timing of a new wave in capital investment appears logical on other grounds. Population experts forecast an upsurge in marriages and births around 1965. So by 1962, industry will be starting to tool up for new mass markets.

The important point is this: As we approach the 1960s more and more sales and investment will be in new products growing out of research. By 1960 well over 10% of manufacturing sales will be in new products not on the market in 1956.

Meanwhile — research will help stabilize capital spending by raising the level of modernization and replacement expenditures. Of course, research does not eliminate all the ups and downs in the demand for capital goods, for there remain variations in the amount spent to expand capacity. But a high level of modernization, to cut costs and improve quality, does put a floor under any drop in investment.

What To Expect

During the next few years we can expect an increasing flow of new materials, new metallic alloys, new machinery — primarily those developments coming out of long-established research programs in the chemical and electrical industries. Industry will make wider use of specialized computers and automated equipment.

But the dramatic payoff on research comes even later. In the early 1960s the consumer goods industries will begin tooling up for their really new products — things so basically new they can change the way a family lives. Such items as plastic houses, paper apparel, turbine autos are under development right now. But it will take several years to get costs down and for population and incomes to grow to the point where mass markets are created.

When we reach that point in the mid-1960s, there will begin the greatest surge of capital investment in all history. And then — around 1965 — the new processes (full automation, atomic power, continuous steel casting) which are the slowest and most expensive part of the research chain to develop, will come into play.

The combined impact of new products and new processes, to meet an expanding market, will thus be felt in the mid-1960s — eight to ten years after the recent sharp increase in research spending. The full impact is that far away because of the lags for applied research, pilot plant studies and market introduction. But to a large degree the prosperity of the 1960s has already been shaped by the research programs now underway.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nation-wide developments. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.

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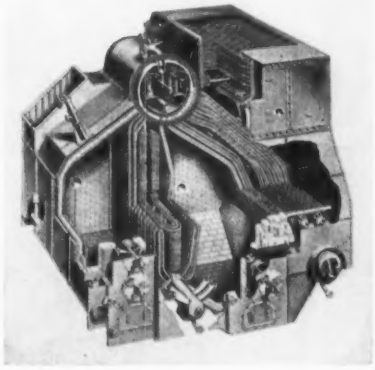

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200	*G.E.	FT-540	3600
200	West.	I-K-13B	1800
200	Brook	CSP-581-S	1800
200	*West.	RS-27	1200
200	G.E.	CS-930-A	900
200	*Al-Ch	KT-564-S	720
200	*West.	AN-37-G	720
200	Al-Ch	CS-1010	600
200	*G.E.	ARW-631	600
150	Cr-Wh	SC-140	3600
150	Al-Ch	AN-30-F	1200
150	West.	CSP-5815	1200
150	G.E.	I-K-15A	900
150	*West.	CS	600
125	Al-Ch	AR-226	1800
125	Cr-Wh	5-Q	1200
125	G.E.	K-558	900
100	W (TE)	CS-507-S	3600
100	G.E.	FT-542-Z	1800
100	Al-Ch (TE)	ARZ-826	1200
100	Al-Ch	AW-23-D	1200

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1. **50% to 80% COST SAVINGS!** You can have the particular equipment your want at a tremendous savings!
2. **NEW EQUIPMENT PERFORMANCE!** Fully reconditioned to perform as per nameplate specifications—AS GOOD AS NEW!
3. **FULLY GUARANTEED!** Your complete satisfaction fully guaranteed on all equipment and every transaction!
4. **LIBERAL TRADE-IN'S!** Tremendous inventory necessitates extensive buying—we must trade higher!

SPECIAL NEW WESTINGHOUSE
Single Step. Primary resistance magnetic Squirrel Cage Motor Starters. 3/60/—Class 11-400

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100 KW to 1500 KW

Diesel Generator Sets • Stationary • Portable • Mobile Motors and Generators

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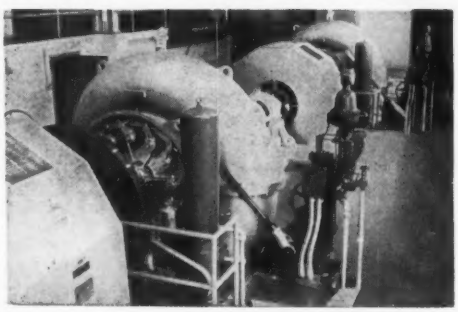
MAIN OFFICE: Box 516, Sausalito, Calif. EDgewater 2-1490

BRANCH: 50 Church St., N. Y. 7, N. Y. Digby 9-4350

TWO 1,500 KW HYDRO ELECTRIC PLANTS



2000 HP Pelton type Turbines, 160 ft. head, 600 RPM 4160 Volt, 3 phase, 60 Cycles, .8 PF, Direct connected excitors, complete modern cubicle. Three 1250 KVA Transformers 66,000-38,150-4160 Volt, and taps. Plants were in service less than four years and are in new condition. Immediate delivery.

GENERAL MACHINERY LIMITED

GRANVILLE ISLAND VANCOUVER, B. C.

ELECTRICAL POWER EQUIPMENT

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	MT	6900	1187
1	1100	F.M. RB	SP806S	4800/2400	1800
1	800	Whse.	CW	550	1776
1	700	Al. Ch.	D.P.	2300	500
1	600	Whse.	CW-432D-15	440	1778
1	500	Whse.	CW	550	350
1	350	Cr. Wh.	SIZE-718R	208/406	1765
1	350	G.E.	IM-17A	440/2200	720
1	350	Whse.	CW-1039C C-15	440	720
1	250	G.E.	MT-424Y	4000	257
1	250	Cr. Wh.	SIZE-290	2300	350
1	250	A.C.		550	600
1	200	G.E.	IM	2200	580
2	200	G.E.	IM	2200	435
2	200	Whse.	CW-890	2300	1775

SQUIRREL CAGE

1	800	G.E.	KT-573	2200	1180
1	500	G.E.	FT-559AY	2300	3600
1	350	Whse.	CS-1115	2300	900
4	500	Whse.	CS-1216	2200	500
2	450	Whse.	CS-1420	2300/4150	354
2	100	Whse.	CS-7151-610H		
1	300	Elliott		6600/4000	3565
1	125	Allis Ch.	BA-684Z	440	1770
1	400	G.E.	AW-23FS	440	1170
2	200	G.E.	1K	2200	560
2	200/150	Whse.	KT-557	440	1800
1	200	Whse.	CS-963H	2300	1175/878
1	150	Whse.	CS-1002	2300/400	450
1	150	G.E.	CS	440	580
			1K-15A	2300	860

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4350	C.W.	3501-SL	13800/6900	514
1	3500	G.E.	TS-6487P	4600/2300/4000	360
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2100/1750	G.E.	514	250/350	2300/4600
1	2000	G.E.	514	600	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	600	600	2300/4150
1	1000	G.E.	900	260	6600
2	1000	G.E.	720	600	6600/13200
1	750	G.E.	720	275	6600/13200
1	500	Whse.	900	125/250	440
1	350	G.E.	900	125	440/2300/4160
2	300	G.E.	1200	250	2300
1	250	Whse.	1200	275	2300
1	200	El Mby	1200	250	2300/4600
1	300	Whse.	1200	600	2300
1	200	Whse.		550	2300
1	200	G.E.	1200	250	550/3300
1	200	Cr. Wh.	1200	250	440
1	150	Whse.	1200	275	2300
1	100	G.E.	1200	250	4160/2400

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	7500	Whse.	650# condensing, 125# auto extraction, 6900 V.
1	5000	G.E.	400# surface condenser 2400/4150 volts.
1	4000	G.E.	400# surface condsenser 2400/4150 volts.

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
3	3333	Whse.	OISC	1	13800x2300
1	1500	G.E.	PYRANOL	3 auto	4000/4200/4400
3	1000	G.E.	OISC	1	13800x460
2	750	G.E.	FUR	1	4800x35/55
3	500	KUHL	OISC	1	13600x6000
1	225	Marcus	Air	3 auto	208/220
3	100	G.E.	OISC	1	22900x2400/4160Y
3	100	Whse.	OISC	1	4600x460/230/115

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
3	6750	G.E.	60/25/60	13200/13200
1	5000	G.E.	60/50/60	11000/6600
2	2500	G.E.	25 cy/62.5	2300/2300
1	500	Al. Ch.	25/60	11000/2300
1	200	G.E.	60/3000	440/880

COMBINATION MILL DRIVES—
D.C. MOTORS WITH M.G. SETS & CONTROLS
PACKAGE DRIVES IN STOCK

1—2250 HP Elliott 300 V. 200/300 RPM DC Motor with 2400 KW GE MG Set. 300 V. DC 2300/4600 V. 450 RPM 3 ph. 60 cy.

1—1375 H.P. G.E., MCF, 415 V. 1300 RPM D.C. motor with 1100 KW G.E. MG Set 415 V DC, 2300/4000 V. 720 RPM 3 ph. 60 cycle.

1—1200 HP G.E. MPC, 600 V. D.C. Motor, 450 RPM, and 1000 KW, G.E. M-G Set, 600 volt DC with 1400 KP, .8 PF, Synch. Motor 13200/6600 volt, 3 ph. 60 cy.

RE-NU-BILT BY

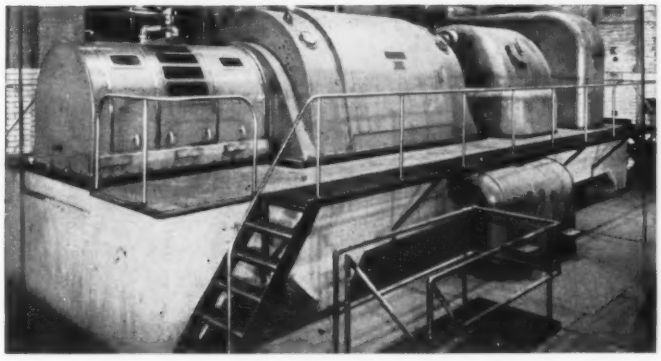
BELYEA COMPANY INC.

43 Howell St., Jersey City 6, N. J.
Tel: OLDFIELD 3-3334

IMMEDIATELY AVAILABLE

650 LB. PRESSURE, 750° FTT TURBINE-GENERATORS

10,000 KW, 70% P.F., 14,286 KVA below:



This 10,000 KW is a Westinghouse, Condensing 650 Lb. PSIG, 750° FTT Turbine. It is equipped with Surface Condenser, Switchboard, with all auxiliaries, direct connected Exciter (closed type). Generator is 3/60/12000 V., 3600 RPM at 70% P.F., 14,286 KVA. Installed new in 1947.

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19701 James Couzens Hwy. **Tel: BRoadway 3-1900** **Detroit 35, Michigan**

MOTORS AND GENERATORS

1500 HP D.C. MOTORS

1500 HP—525 volts D.C.—600 R.P.M.—NEW—2-bearing continuous duty motors—manufactured by Westinghouse. In original crates. From Navy Destroyer Escort. SPECIFICATIONS: 2-bearing 1500 HP—525 volts DC—2270 amps—600 RPM—ambient temperature 40C—class B insulation—2-bearing pedestal sleeve type—shunt wound—efficiency 94.23%. ONLY 6 AVAILABLE—BUY NOW AND SAVE. Suitable for steel mill drive—offshore oil rigs—rolling mill drive—dredge pump applications.

1200 KW GENERATORS

(2) Equal to new—manufactured by Allis-Chalmers. 1200 KW—525 volts D.C.—2290 amps 750 RPM—cooling self-ventilated—totally enclosed—separate excitation—continuous duty—class B insulation—mfg type M.H.C.—frog leg armature.

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Thousands of new and "Certified Rebuilt" Motors & Generators in stock—up to 1000 H.P. OUR 52nd YEAR

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
700	Whse.	Slipring	2300/4000	1200
500	G.E.	Slipring	2200/440	600
500	Whse.	Slipring	2200	450
400	Whse. (2)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
400	Whse	Sq. Cage	2300	900
400	G.E. (2)	Slipring	440	900
400	G.E.	Slipring	2300	514
350	G.E.	Sq. Cage	2200	1800
350	Cent. b.b.	Slipring	2300	900
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/4000	600
300	El.Machy (2)	Synch.	2200/440	720
300	G.E.	Slipring	2200/440	600
300	G.E. (2)	Synch.	2200/440	360
300	Whse.	Synch.	440	1200
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Slipring	220/440	720
250	G.E.	Sq. Cage	2200	1800
225	G.E.	Synch.	220/440	900
200	I. A. TEFC	Sq. Cage	440	1200
200	G.E. (4)	Slipring	2200	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Allis Ch.	Slipring	2300/440	720
200	Whse.	Sq. Cage	2200/440	900
175	G.E. (2)	Synch.	220/440	720
150	Rel. TEFC	Sq. Cage	220/440	900
150	G.E. (4)	Slipring	2200/440	600
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E.	Slipring	220/440	450
150	G.E. (2)	Sq. Cage	2200/440	1800
125	G.E. TEFC	Sq. Cage	2200	3600
125	Ideal	Slipring	4000/2200	900
125	Al. Ch. TEFC	Sq. Cage	220/440	900
100	Whse. TEFC	Sq. Cage	220/440	900
100	Smith b.b. (6)	Sq. Cage	220/440	1800

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	G.E. b.b.	CD	250	1800
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	650
125	Gen. Elec.	CD	250	1150
100	Allis Ch.	E	125	1200
100	Reliance	651-T	600	1200
75	Gen. Elec.	CD-123	125/250	1200
60	Allis Ch. (3)	E-146	250	1500
60	Ideal	D	125	1150
25	Whse.	SK-103	250	1750

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
200	G.E. b.b.	CY-290	230	1750
170	Cr. Wh.	151-H	230	580
150	Whse.	SK-184	230	850
150	Whse.	SK-210	230	320/1000
125	G.E.	CD-173	230	575/1150
100	Reliance	651-T	550	1000/1600
100	Elliott b.b. T.E.	JH-FE	230	1150
60	G.E. TEFC b.b.	CD-135	230	1150
50	G.E. b.b.	CD-123S	230	500/1500
50	Century	DN-514	230	1150/1750
50	Gen. Elec.	CD-95	230	1800
50	G.E.	CD-125	230	400/1200
50	G.E.	RF-16	230	250/1000
40	G.E. (2)	CD-93	230	1750
25	Whse. (2)	SK-153	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	G.E.	2200/440 AC	600 DC
175	Gen. Elec.	220/440 AC	250 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
100	Gen. Elec.*(2)	220/440 AC	250 DC
75	Gen. Elec.	220/440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Allis Ch.	220/440 AC	250 DC
50	Cr. Wh. b.b. (2)	220/440 AC	250 DC

Arthur Wagner Co. Certified

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1435 W. RANDOLPH ST
CHICAGO 7, ILLINOIS

MISS POWER EQUIPMENT SAYS,

"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed New and Rebuilt Motors"

SQUIRREL CAGE MOTORS NEW AND GUARANTEED REBUILT

HP	Make	Type	Speed
400	West. B.B. Drip.	CSP-681S	1800
400	West. S.B. Open	CS	900
350	A.C. S.S. Drip	ARWW-626	3600
300	G.E. S.B. Open	IK	1800
300	A.C. S.B. Open	AR-630	1800
300	F.M.-B.B. Open	H	1800
300	G.E. S.B. Open	IK	900
300	G.E. S.B. Open	IK	720
300	West. S.B. Open	CS-1002	600
250	G.E. TEBB, 2300 V	K	1800
250	G.E. S.B. Open	KT	1800
250	F.M. B.B. Open	H	1800
250	G.E. S.B. Open 2200 v	IK-16	1200
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	G.E.T.E.F.C.BB.	K6329	3600
200	G.E. S.B. Drip	K-6326	3600
200	G.E. T.E.F.C.B.B.	K-6329	3600
200	F.M. B.B. Open	H-207	1800
200	G.E. TEBB	K	1800
200	A.C. S.B. Open	ARW-626	1800
200	G.E. S.B. Open	KT-558	1800
200	Cont. T.E.F.C. B.B		1800
200	GE. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-15S	1200
200	G.E. S.B. Open	KT-562	1200
200	G.E. S.B. Open 2200V	IK	1200
200	G.E. S.B. Open	IK	900
200	Cont. T.E.F.C.B.B.	NP686C	1800
200	West B.B. Drip	CS-581	1200
150	G.E. TEFCBB	K-632R	3600
150	G.E. TEFCB XP	K	3600
150	G.E. TEBB	K	1800
150	West S.B. Open 2200V	CS	1800
150	G.E. S.B. Open	IK	1800
150	Wst. S.S.B. Opn	CS-761C	1800
150	West. S.S.B. 2200V Open	CS-772C	1200
150	Cant. T.E.F.C. B.B. New		900
150	G.E. S.B. Open	IK	720
125	G.E. TEFCBB	K	3600
125	West. S.S.B. Open New	CS-607	1800
125	G.E. S.B. Drip	K-505	1800
125	G.E. S.B. Open	IK	1800
125	West. S.S.B. Open	CS-761C	1800
125	G.E. S.B. Open	KT-553	1200
125	G.E. S.B. Open	IK	1200
125	G.E. S.B. Open	IK	900
125	G.E. S.B. Open	IK	720
125	G.E. S.B. Open	IK	600
100	A.C. S.B. Open	AR-505S	3600
100	G.E. S.B. Open	KT-343	1800
100	A.C. S.B. Open 2200 V	ARX	1800
100	G.E.-B.B. Open	K-504	1800
100	G.E. S.B. Open	KT-347	1200
100	West. SSB Open	CS-607	1200
100	West. SSB Open	CS	1200
100	A.C. SB Open 2200 Volt	ARX	1800
100	G.E. S.B. Open	IK	900
100	G.E. S.B. Open	KT-256	900
100	G.E. S.B. Open	IK	720
75	G.E. B.B. Drip	K-444	3600
75	West. T.E.F.C. B.B. New	CS-754C	1200
60	Wagner T.E.F.C.B.B. New	CP-504	1200
60	Wagner T.E.F.C.B.B. New	CP-505	900

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POWER EQUIPMENT CO.

8 CAIRN STREET • PHONE BEverly 5-1662 • P. O. BOX 534 • ROCHESTER 2, N. Y.

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
1	3000	G.E.	OATU-D (oil)	3	69000/34500/4160/2400
2	3000	Mal	TCR	3	7200/6600-4160/2400
2	750	G.E.	K	1	4600-120/240
1	750	G.E.	HT	3	4150Y-208/416
1	600	West.	Power Ctr.	3	2400-120/240/480
3	500	West.	SL		4800/2400-240/480
1	300	West.	Power Ctr.	3	2400/4160Y/240-480
1	300	Penna.	(Askarel)	3	12470Y/7200-240
2	250	G.E.	H Pyranol	1	4800/8320Y/120/240
2	250	West.		1	2300/4600-230/460
3	200	G.E.	H	1	7800-15600-220/440
1	150	Elaler	OA	1	4160-240/480
3	100	West.	(Air) VR	1	480/240-240/120
3	100	G.E.	H		2400/4160-240/480
3	50	G.E.	HS	1	2400/4160/240/120
1	50	Amer.	Abeatol	3	4160-120/208Y
5	50	G.E.	HS	1	2400/4160-240/480
3	3.75	West.	(Air) VR	1	480/240-240/120
3	3.75	West.	S	1	2400/4160Y/120/240
4	25	West.	Hyperail	1	2400/4160-120/240
3	15	West.	H Pyranol	1	6900/11950Y-120/240

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
3	60	E.M.	1200	125	220 v. Syn.
2	100	West.	1200	250	2300/4150Y Syn.
1	150	Cr. Wh.	600	125	220/440
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y S.R.
1	300	G.E.	1200	250	440 Sync.
1	1000	West.	720	600	2300/4160Y

ENGINE GENERATOR SETS

1—Hercules Gas HXE 62.5 KVA Watghe 3/60/480—1200

1—Wisconsin Gas (Air) PE-99 7.5 KVA Master 1 or 3/120—2200 r.p.m. NEW.

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	690	CW	220/440
1	60	G.E.	1800	MT	220
1	75	G.E.	600	IM	440
2	100	West.	1800	T.E.F.C. B.B.	220
1	150	G.E. Triclad	1175	M	220/440
3	150	Allis-Ch.	1800	AY-RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	500	G.E.	450	MT	2200
1	500	G.E.	1200	M569Z	2300/4160Y

EXPLOSION PROOF

2—200 HP Continental NP716Z—BB—1800 r.p.m. 3/60/220/440

1—30 HP Louis Allis 444—BB—1200 r.p.m. 3/60/220/440

D.C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	75	Cr. Wh.	860	WP 53 H
1	75	Star	1200	SB 60 L B.B.
1	350	G.E.	1200	Pedestal

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J. L. HEMPHILL & CO.

3403 54th STREET, NORTH BERGEN, N. J.

MODERN SWITCHGEAR

IN STOCK — IMMEDIATE SHIPMENT

500-KVA WHSE. Transformer, 3 ph., 60 cycle, Inerteen filled, 13,200-V. Prim., 130/208-V. Sec. with coupled Prim. Switch and secondary cubicle with (1) 1600 amps., (2) 600 amps., (8) 225 amps. air circuit breakers.

GENERAL ELECTRIC 6-section cubicle, with (5) type FKR-225-150, 3-P.S.T., 600 amps., 15-KV Mag. Draw-out O.C.B.'s, complete with metering equipment. 150-M.V.A.

GENERAL ELECTRIC 7-section, OUTDOOR Cubicle with (5) AM-5-100-4Z, 1200 amps., 5-KV mag. Draw-out Air Breakers, with all metering, batteries, charger, etc., 10-M.V.A.

SAVE $30,000. ON THIS PACKAGE

(1) 400 AMPS. 73-KV WHSE. OUTDOOR 3-pole Mag. O.C.B. type G-11-500-M.V.A.

(1) 600 AMPS. G.T. type F.L.O. 14.4-4-250, 3-pole Mag OUTDOOR O.C.B., 250-M.V.A.

(1) 600 AMPS. AL. CH. type FZO-50-34X, OUTDOOR 3-pole Mag. O.C.B. 34.5-KV, 250-M.V.A.

(1) WHSE. OUTDOOR 3-section cubicle with (2) 600 AMPS., 3-pole Mag. O.C.B.'s, type F-100, 15-KV, 100-M.V.A. with complete metering.

WEST COAST BUYERS—NOTE—Stored in Seattle—Priced, Right.

(6) G.E. 2500-KVA Transformers, new 1945, Prim. 14,490/13,110; Sec. 2300/4000-Y.

SAVE 50%

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OPPORTUNITIES!

in

New and used equipment recently released from service by a number of electric and gas utility companies

POWER PLANT EQUIPMENT
CONSTRUCTION EQUIPMENT
SUBSTATION EQUIPMENT
TRANSMISSION LINE MATERIALS

Send for new list . . . to

EBASCO SERVICES INCORPORATED
APPARATUS EXCHANGE
Two Rector St., New York 6, N. Y.

FOR SALE

15 NEW TURBINES

4 horizontal, 11 vertical, Westinghouse

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. De ROSE
2457 WOODWARD AVE.
706 DONOVAN BLDG.
DETROIT 1, MICH.

FOR SALE

HIGH PRESSURE BOILER

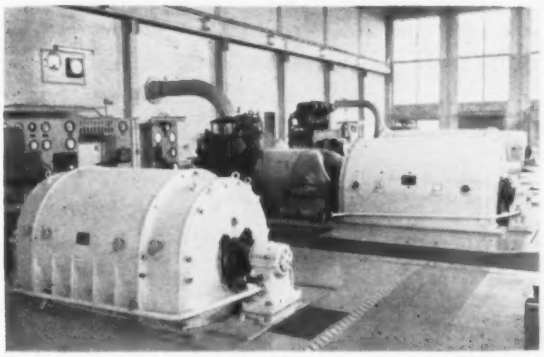
35,000 pound steam per hour Combustion Engineering boiler, type VU, two drum, bent tube, 450# steam pressure, 825° FTT, complete with spreader stoker and automatic control.

New 1950—Excellent Condition

INTERNATIONAL POWER MACHINERY COMPANY
1612 Union Commerce Building
Cleveland 14, Ohio MAin 1-9514

SPECIAL OFFERING!

650 lb., 725 DEG TURBO GENERATORS — Still on Original Foundations As Shown in Photo Below — All Westinghouse, 3600 RPM, 80% P.F., 6900 V, 3/60.



1—9375 KVA, 7500 KW, 125 P.S.I.G. auto extraction, surface condenser, installed in 1937.
1—9375 KVA, 7500 KW, non-condensing, 125# B.P., installed 1930.
1—6250 KVA, 5000 KW, Condensing, with surface condenser, installed 1942.

•

BELYEA CO. INC.

43 HOWELL STREET — **JERSEY CITY 6, N. J.**

N. J. Phone: OLdfield 3-3334
N. Y. City Phone: REctor 2-7150

COAL ELEVATOR

78' high 20 ton per hour, bucket elevator complete with track hopper and 24' flight feeder. Used only 6 years, and is in excellent condition. Can be purchased for less than half its original cost of $15,500.

PRIVATE UTILITIES, INC.
Cleveland, Ohio — Phone: Cherry 1-0036

1902 COMPRESSORS 1958
WORLD'S BEST REBUILTS

100 CFM 125 psi 6x7 Ing.
138 CFM 100 psi 7x7 Ing. ES-1
140 CFM 3500 psi 12¼x10 Norwalk—unused.
191 CFM 350 psi 9-4x9 Ing. ES-2
238 CFM 100 psi 9x9 Ing. ES
268 CFM 500 psi 10-4¼x10 Ing. or Worth.
465 CFM 100 psi 12x11 Penn. or Ing.
502 CFM 125 psi 12x18 Worth. HB.
585 CFM 100 psi 15-9¼x12 Ing. XRE 3-60-4160
590 CFM 100 psi 13½-8x8 Penn DE2 3-60-220
676 CFM 100 psi 15-9¼x12 Ing. XRB—Worth.
686 CFM 100 psi 14x13 Worth. HB.
870 CFM 125 psi 17-10½x12 Ing. XRE 3-60-220
1007 CFM 100 psi 19-11x12 Chic. OCB
1410 CFM 35 psi 20x13 Worth. HB—unused.
1721 CFM 125 psi 23-13x16 Chic. OCE 3-60-2300
2832 CFM Vacuum 31x13 Ing. St. or Elec.
PORTABLES—55-60 CFM Rotary or Reciprocating

AMERICAN AIR COMPRESSOR CORP.
Dell Ave. & 47th St. North Bergen, N. J.
UNion 5-4848

BARGAIN OPPORTUNITY

600 HP—720 RPM, General Motors Model 567 Electro Motive Diesel engine direct connected to a:

500 KVA—400 KW at 80% PF, 720 RPM, 3 phase 60 cycle, 480 volt Westinghouse alternating current generator.

Complete installation. Equivalent to new.

EUCLID ENGINEERING CORP.
609 National City E. Sixth Building
Cleveland 14, Ohio

FOR SALE—EXCEPTIONAL BARGAINS

Diesel Generator Units, 200 KW-1500 KW — Turbo Generators, 500 KW-10,000 KW
Motor Generator Sets—Rotary Converters—Synchronous Condensers—
Frequency Changers—Transformers—Pumps, Boilers.

UTILITIES MACHINERY CORPORATION
1965 East Sixth St., Cleveland 14, Ohio • PHONES: CHerry 1-0210 & CH 1-4070

---

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
800	4000/2300	G.E.	600
450	440	Whse.	514
400(2)	2300	G.E.	900
400	4000/2300	Whse.	720
300	2300	G.E.	450
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (hoist)	600
300	440	Whse.	3400
225	4000/2300	G.E. (hoist)	600
200	2300	G.E.	600
200	2300/440	G.E.	720
150	220/440	Whse.	730
125	2300	G.E.	600

SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2300/440	G.E.	ATI	720
350	440/220	El. Machy.	Syn.	1200
300	2300/400	G.E.	TS	720
300	2300/440	G.E.	TS	1200
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

500	2300/4000	Elliott	SC	1800
350	2300/440	G.E.	IR-K	1200
300(2)	2300	G.E.	PT	3600
300	2300/4000	L. Allis	PS	1800
250	440/220	G.E.	KT	720
200	440/220	G.E.	KT	1400
200	2300	G.E.	KT	1800
200	440/220	G.E.	KT	720
200	2300/440	G.E.	IR-K	1200
150	440	Whse.	X-prf.	3600
150	2200	Al. Chal.	AR	1800
150	440/220	G.E.	KT	730
150	2200/440	G.E.	TEFC	720
150	2300/440		KT	900
150	2300/440	G.E.	PT	1200
125(2)	2300/440	Whse.	X-proof	720
125	2300/440	G.E.	K	600
100(2)	4000/2300	L. Allis	OX	1200
75(2)	440	Wagner	TEFC	1800

A. C. GENERATORS

1—320 kva, 660 rpm, 2300/440/220 V., G.E.
1—360 kva, 900 rpm, 2300 V., Whse.
1—187 kva, 1200 rpm, 2200/440 V., Whse.

CIRCUIT BREAKERS

9—1600 amp ITE, 3 pole, 600 V.
6—FKB-185-28, 600 amp., 15,000 V. G.E.
1—400 Amp. R. Smith, 3 P 7.5 KV outdoor

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
225	230	Whse.	SK	1800
200	230	Cr. Wh.	CMC	1200
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	850

MOTOR GENERATOR SETS

		Input V.,	Motor	Output V.,
KW	Make	AC	Type	DC
250	Whse.	440	Syn.	250
125	G.E.	440/220	Sq. Ca.	125
125	G.E.	440	Sq. Ca.	250/125
100	G.E.	2300/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
65	G.E.	2200/440	Sq. Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva, Al. Ch., 2400/4160Y—600 volts, 3 ph.
3—600 kva, G.E., 13,800—3300 V.
3—333 kva, G.E., 13,800—2300 V.
3—333 kva, G.E., 2400-240/480 V.
2—300 kva, G.E., 4150—240 V., 3 ph., Pyr.
1—300 kva, Al. Ch., 6900—230 V., 3 ph.
3—200 kva, Whse., 4600/2300—230/115 V.
1—200 kva, G.E., 2400—120/240 V., Pyr.
3—200 kva, Mot., 13,800—2300 V.
3—150 kva, Al. Ch. 2400—220 V.
3—150 kva, Al. Ch. 440-220 V., dry New
3—150 kva, G.E., 13,200—2300 V
3—100 kva, Whse. 4800/2400-240/480 V., Dry
3—100 kva, G.E., 2400—120/240 V., Pyr

GASOLINE—ENGINE GENERATOR SETS

1—94 kva 1200 R 220 V 3 ph. Buda, 6 cyl.
ABOVE SLIGHTLY USED, FOLLOWING NEW
2—35 kva 900 R 220 V 3 ph. conn. LeRoi, 6 cyl.
2—25 kva 900 R 120/240 V 1 ph conn. LeRoi, 6 cyl.

only partial listing

STEPHEN HALL & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

COMPLETE NEW 4600 KW TURBO POWER UNIT

4600 KW General Electric Generator, type ATB-2, complete with air cooler, 93-1/3 cycle, 3 phase, 2700 volt, 984 amps. 5600 RPM (output 2950 KW, 60 cycle, 3 phase, 1700 volts at 3600 RPM)

6180 HP General Electric Condensing Turbine, 410 PSI at 724 Deg. F., exhaust 28.5" HG, complete with throttle valve and 3800 square foot Foster Wheeler condenser with steel shell, cupro-nickel tubes and tube sheets, monel water boxes.

PRICED AT A FRACTION OF ORIGINAL COST

NEW CONDENSERS

14750 SQ. FT. Westinghouse, Single Pass, Steel Shell, Cupro-Nickel Tubes and Tube Sheets, Monel Water Boxes.

11000 SQ. FT. C. H. Wheeler, Single Pass, Steel Shell, Cupro-Nickel Tubes and Tube Sheets, Monel Water Boxes.

3800 SQ. FT. Foster Wheeler, Single Pass, Steel Shell, Cupro-Nickel Tubes and Tube Sheets, Monel Water Boxes.

3500 SQ. FT. Alco, 2 Pass, Admiralty Brass Tubes, Naval Brass Tube Sheets, Steel Shell, Cast Iron Water Boxes.

2200 SQ. FT. Alco, 2 Pass, Steel Shell, Cupro-Nickel Tubes and Tube Sheets, Gun Metal Water Boxes.

2000 SQ. FT. Newport News, 2 Pass, Steel Shell, Cupro-Nickel Tubes and Tube Sheets, Bronze Water Boxes.

1350 SQ. FT. Alco, 2 Pass, Steel Shell, Cupro-Nickel Tubes and Tube Sheets, Bronze Water Boxes.

1250 SQ. FT. Westinghouse, 2 Pass, Steel Shell, Cupro-Nickel Tubes and Tube Sheets, Bronze Water Boxes.

1050 SQ. FT. New York Shipbuilding, 2 Pass, Steel Shell, Cupro-Nickel Tubes and Tube Sheets, Bronze Water Boxes.

725 SQ. FT. C. H. Wheeler, 2 Pass, Steel Shell, Cupro-Nickel Tubes and Tube Sheets, Bronze Water Boxes.

580 SQ. FT. Foster Wheeler, 2 Pass, Steel Shell, Cupro-Nickel Tubes and Tube Sheets, Bronze Water Boxes.

436 SQ. FT. C. H. Wheeler, 2 Pass, Steel Shell, Cupro-Nickel Tubes and Tube Sheets, Bronze Water Boxes.

400 SQ. FT. Allis Chalmers, 2 Pass, Steel Shell, Brass Tubes and Tube Sheets, Bronze Water Boxes.

NEW FEED WATER HEATERS Struthers Wells, 206 Square Feet of Surface, 6 Pass, Steel Shell, Brass Tubes and Tube Sheets, Bronze Heads.

NEW ELLIOTT FLUID DEAERATING HEATERS 246,500#/HR, 1000 Gallon Tank Capacity Monel Construction.

EASTERN SCRAP & SALVAGE CORPORATION
65 Muirhead Avenue, Trenton 7, New Jersey

BARGAINS NEW CONDENSER

11000 SQ. FT. UNITS

3 New Worthington Surface Condensers—11000 sq. ft. each—single pass—Monel water boxes—Cupro-Nickel tubes & tube sheets. Tubes ⅝" O.D CAPACITY. lbs/hr—70,000; circulating water 14180; circulating water connections 30"; operating weight 86,000 lbs; overall length approx. 21'- width & height 9'4" Built for U.S. Navy. Designed for low head room.

8900 SQ. FT. UNITS

1 New unit by C. H. Wheeler. Test pressure: shell 30 lbs; water box 30 lbs.—single pass. Turbine steam exhaust inlet 6' 1¾" x 10' 2". Overall width 12' 2¼"; overall length 14' 10¾"; overall height 5'7". Water inlet 36" x 30" outlet. Monel heads and water boxes; Cupro-Nickel tubes. Built for U.S. Navy of very best materials.

1135 SQ. FT. UNITS

2 New Units by C. H. Wheeler. 2-pass—shell 30 PSI—tubes, chest 30 PSI: DIMENSIONS: 42" diam.—12' long. 24" exhaust steam inlet —water box inlet & outlet 10". 9300 lbs./hr. steam capacity; 1175 GPM circulating water. Complete with twin air ejectors type 4H Wheeler with inner cooler. Built originally for Navy.

580 SQ. FT. UNITS

6 New units—Capacity: 4300 lbs/hr on 28.5 vacuum. 8" water inlet & outlet—18" steam inlet. 2 pass— complete with air ejectors.

3 LIBERTY SHIP TYPE UNITS

2700 Sq. Ft.—2-pass type.

OTHER SIZES IN STOCK FOR IMMEDIATE DELIVERY

NEW CIRCULATING PUMPS

1 only—vertical circulating pump—all-bronze propeller type—geared turbo driven—840 RPM —26500 GPM at 25' head. W.P. turbine, Westinghouse, 575 lbs—0°F superheat. Pump—Warren type 25 VP.

THE BOSTON METALS CO.
313 E. BALTIMORE STREET
BALTIMORE 2, MD. ELgin 5-5050

POWER PLANT EQUIPMENT

SPECIAL OFFERINGS

TURBO-GENERATORS

1—3000 KW — 13,200 V — N. C. 425# — 170 Ext.—50# BP
1—3000 KW—4150 V 350# Cond.
2—2000 KW—6600 V—N. C. 625#—155# BP
1—1000 KW—240/480 V—Cond. 130/250#—Ext. #15
2—750 KW—250 V—DC—N. C. 250#—25# BP
1—300 KW—480 V—Cond. 210#—Ext. 40#
1—250 KW—240/480 V — N. C. 130# — 10/15# BP

DIESEL LOCO. CRANE

1—25 Ton—50 Ft. Boom.

A. LEE ELLIS CO., U.S. Machy. Bldg., 140 Federal St., Boston 10, Mass.
THE BUYERS MUST BE SATISFIED—ALWAYS

A.C. GENERATOR SET

Unused and unassembled 300 K.W. 400/230/1/50 with 575 H.P. 375 R.P.M. Worthington diesel packed in 22 substantial cases ready for immediate shipment from U.K. port. Inspection invited, certificate given if required. Will accept $25,000 F.O.B. for quick sale.

EVANS OF LEEDS
Waterloo Lane, Bramley, Leeds, England.
Cable "Evanseas".

COMPLETE DIESEL PLANT

2—Fairbanks Morse 450 HP Model 32E14 375 KVA. 3/60/2400 volts. With complete auxiliaries. New in 1944.

1—Fairbanks Morse 360 HP Style VA, 257 RPM 300 KVA. 3/60/2400 volts. With auxiliaries.

These units can be purchased individually at a real bargain price. Condition is first-class.

WHISLER EQUIPMENT CO.
611 Olive St. St. Louis 1, Mo.
CH. 1-4474

BOILERS

HI-PRESSURE
Complete stock from 10-2,000 h.p.
Nation's largest inventory, New & Used

WABASH POWER EQUIPMENT CO.
9750 Skokie Blvd., Chicago (Skokie) Ill. OR 3-8118

2—600 HP B&W Sectional Hrd. WT Boilers
5 & 20 Ton OET Cranes W/A.C. Motors
30-40-80-125-400-500 HP Package Boilers
75,000 Gal. x 147' Water Storage Tank
600' Diesel Portable Air Compressors
72"x20' & 84"x20' 150# HRT Boilers
50 HP Kewanee & Erie City Boilers
156 & 230 KVA AC Gens. or Syn. Mtrs.
H. & P., 6719 Etzel, St. Louis 14, Mo.

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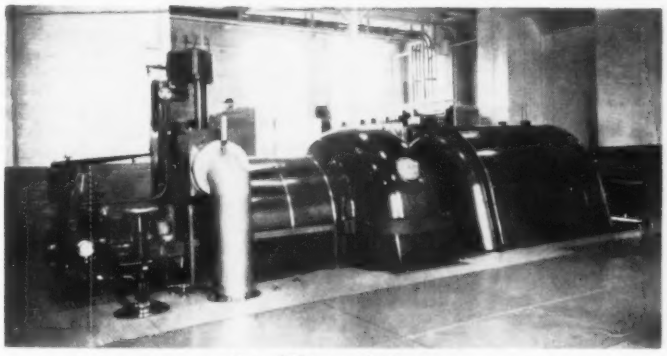
BARGAIN OFFERING

6250 KVA—5000 KW, 80% P.F. TURBINE GENERATOR
400 PSIG, 700°FTT 3 PHASE 60 CYCLE 2400/4160 VOLTS



(Actual Photograph Above)

5000 KILOWATTS 3600 RPM

5000 KW, General Electric condensing turbine generator unit, complete installation with surface condenser, auxiliaries and direct connected exciter. Excellent condition.

UTILITIES MACHINERY CORPORATION

1965 EAST SIXTH STREET TELEPHONES: CH 1-0210 & CH 1-4070 CLEVELAND 14, OHIO

FOR SALE
TWO DIESEL ENGINES

1670 HP. 750 rpm. Fairbanks-Morse, 10-cyl., 2-stroke, opposed piston, excellent condition.

INGENIORSFIRMAN MYREN & CO.
GOTHENBURG — SWEDEN
Cable: Elektromyren

POWER EQUIPMENT

2000 KW G.E. Non-C. Extr TURBINE 3/60/480 V 600# 650° TT 150# Extr. 30#BP 3600 RPM

75000# Combustion Engineering 600# 650° TT BOILER oil fired

500 KW 3 ph 60 cy 4150 V G.E. FEEDER VOLTAGE REGULATOR step type MLT-32—New

BREW, WOLTMAN & CO., INC.
50 Church St., New York 7, N. Y.

TRANSFORMERS

3—833 KVA, 1/60/34500-460 Moloney OISC with taps
2—250 KVA, 1/60/2400-240/480 Moloney OISC, type YC, with taps
1—300 KVA, 3/60/4160-240 Wagner, ITE type HPE Unit Substation, Outdoor.
1—200 KVA 3/60/4160-240 Wagner, ITE type RPB Unit Substation, Outdoor.
1—225 KVA 3/60/440-208Y/120, Moloney Dry type.
5—10 KVA, 1/60/240-480/120-240 Sorgel Dry type

CASH
For Surplus Electrical Equipment
BENSON-WILIMZIG, INC.
1708 North 8th St., St. Louis 6, Mo.
Phone GArfield 1-4290

FOR SALE

Steam mixed pressure bleeder turbine with condenser; Terry turbine type GZF8 1949 rated 800 HP at 4100 RPM with 140#-30#-20" vacuum. Worthington surface condenser for above turbine 1010 square feet in Admirality tubes, over all size 39½" x 14'2".

Turbine driven York VW Ammonia Compressors consisting of 400 HP DeLaval steam turbine type MCA and DeLaval direct connected gear reducing unit on common bed plate, 4540/720 RPM with rubber shear couplings driving two York 6¾ x 5 eight cylinder ammonia compressors, complete with Ammonia oil separators and oil return traps, plus, ample spare parts and panel board with automatic air controlled system. Original installation June 1951. Compressors rated 250 tons ammonia. Over all floor space 71½' x 20'.

Can be seen in place at:

P. BALLANTINE & SONS
57 Freeman Street, Newark 1, N. J.

HIGH PRESSURE STEAM BOILERS

Government Surplus SAVE OVER 75%

NEW, NEVER USED, NEVER ERECTED, AVAILABLE IMMEDIATELY

121,650 Lbs.

1 Foster Wheeler
Express Type, 3-drum, with integral superheater separately fired.
Includes boiler, superheater, economizer, 7 fuel oil burners, soot blowers.
Pressure 634 psi, temp 850° F.
Furnace Vol: boiler 310 cu. ft., superh. 247 cu. ft.

60,000 Lbs.

10 Babcock Wilcox
3 Foster Wheeler
"D" Type, 2-drum, with integral superheater fired between boiler tube bank.
Includes boiler, superheater, economizer, 3 fuel oil burners, soot blowers.
Pressure 435 psi, temp 750°F.
Furnace Vol: 330 Cu. Ft.

We own and stock these boilers. Inspection Invited at Utica, N.Y. Subject to prior sales.

PELNIK-LOCONTI INDUSTRIAL SUPPLY CO.
Office Ph. Utica 6-4621 • 315 Oriskany St., Yorkville, N.Y. • Yard Ph. Utica 2-4513

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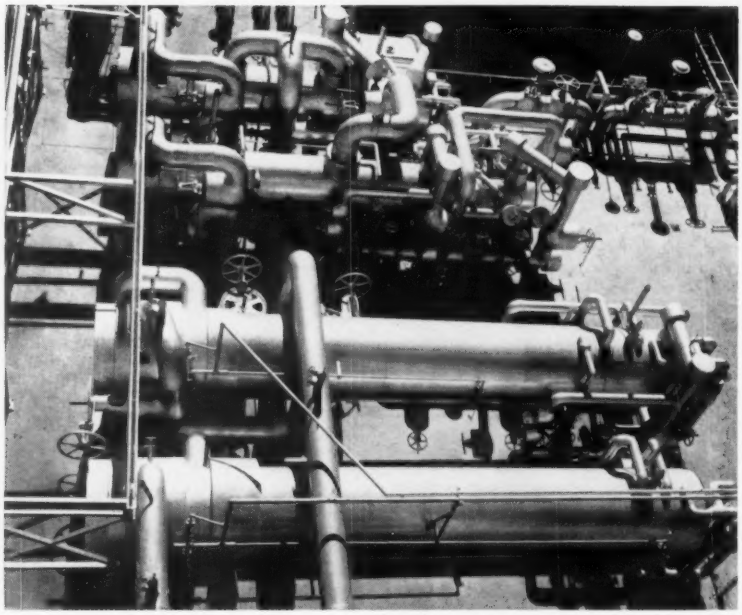

Consulting Engineers, Ebasco Services Incorporated

The modern, efficient equipment shown here was designed and built by the Yuba Heat Transfer Division for the Collin Station of the Texas Power & Light Co. Serving a 110,000 KW turbine are five Yuba feedwater heaters, of which four are shown here. Two high-pressure heaters are designed for 2600 psi on the tube side with 6500 and 6750 sq. ft. of surface. Three low-pressure heaters are designed for 400 psi on the tube side and have 2850, 3165 and 4670 sq. ft. of surface.

Yuba designed and built the first all-welded feedwater heaters, in service for the last year and a half. The weld technique was used in the tube bundles, shells and Multilok Closures. These all-weld heaters have been so successful they have started an industry trend.

In the manufacture of condensers, Yuba is building units having 165,000 sq. ft. of total surface. The designs are readily adapted to condensers of even greater capacity as required for larger turbines.

Yuba evaporators have achieved boiler make-up water purity of less than .2 ppm. Yuba can *guarantee* purity of .25 ppm solids content per 3000 ppm shell concentration.

Engineering accomplishments such as these keep the power industry up-to-date. There's progress in power through progress in heat transfer equipment.

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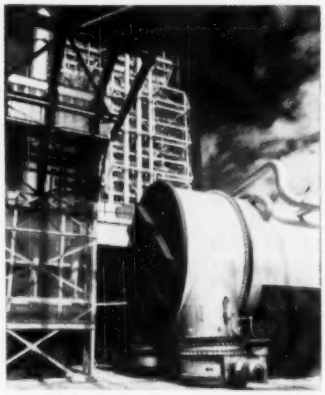
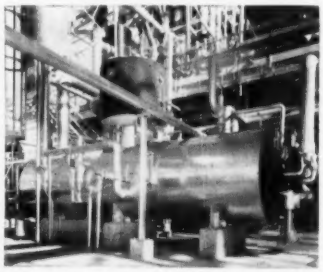


Twin-unit surface condenser has 90,000 sq. ft. of surface. Operates at 26.52 inches of vacuum with oxygen content in the condensate less than 0.01 cc per liter.



Bubble-tray evaporator produces 34,000 lb./hr. of vapor well below 1.0 ppm total solids with 3000 ppm concentration.

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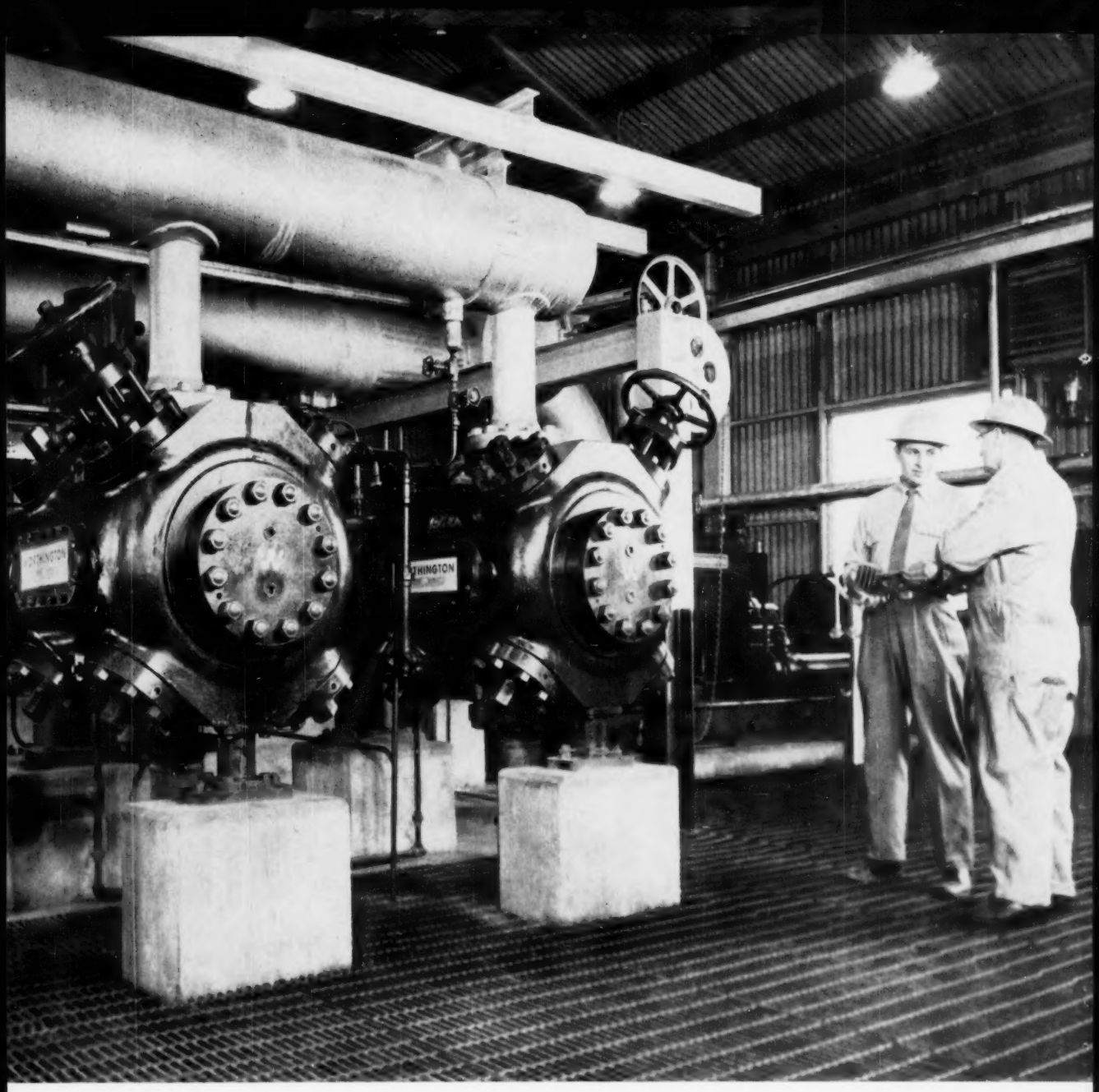

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